SPEECH

OF

MR. JEFFERSON DAVIS, OF MISS.,

ON THE SUBJECT OF THE

COAST SURVEY OF THE UNITED STATES:

Delivered in Senate of the U. S., Monday, Feb 19, 1849.

The Senate, as in Committee of the Whole, having proceeded to the consideration of the bill making appropriations for the civil and diplomatic expenses of the Government for the year ending June 30, 1850—

Mr. BENTON moved to strike out the clause appropriating $186,000 for defraying the expenses of the coast survey, including compensation to the superintendent and assistants, and to insert in lieu thereof the following:

"For survey of the coast of the United States, the sum of $30,000; and from and after the 30th day of June, 1849, the said survey shall be carried on exclusively by the Navy Department, under the direction of the President of the United States."

Several members having addressed the Senate on the subject—

Mr. DAVIS, of Mississippi, said—

Mr. PRESIDENT: The amendment offered by the Senator from Missouri (Mr. BENTON) offends against the advice of St. Paul, which tells us to "prove all things, and hold fast that which is good." It proposes to go back to an old exploded system, an experiment made in 1818, which, after years of lost time and millions of lost money, was finally abandoned. It is to abandon an organization more perfect than, I believe, any country has ever before possessed for such a purpose, and to return to one, because it might imitate that of Great Britain, the imperfections of which stand forth upon every map of the British island. Let any man obtain two hydrographic maps—take one issued by the Coast Survey, and one issued recently by Great Britain—and he will find that science and intelligibility stand forth as the prominent features of the one, and confusion in the other; sometimes, even, surveys marked by square lines where the lines of equal depth are curved, and can have no natural relation to the rectangles thus presented.

I was sorry to hear the chairman of the Committee on Finance propose that this matter should be investigated by a committee, and made the subject of a separate bill. It is before us, and we are as ready to decide it now as at anyother time.

Mr. ATHERTON. I did not mean to say that it should be made the subject of a separate bill.

Mr. DAVIS. It is useful and desirable that the question should not only be settled now, but that it should be quieted for all time. I believe more than one-half the valuable labors of that distinguished astronomer, Mr. Hassler, were lost to science and the country, in consequence of his constant wrangling with Congress to obtain appropriations. His mind was diverted from the pure pursuits of science, and he has, in consequence, left behind him comparatively little of those results which we should have expected from his high reputation.

I desire, therefore, Mr. President, that the Senate will consider the whole question now; and I hope that they will settle it by such a majority as was given in the House last session, where I think the vote stood 90 to 36 after a full discussion.

The object of the Senator from Missouri, in his amendment, is to give up the whole coast survey to the navy, and return to the law of 1818. Now, sir if the proposition had been to give up the whole to the army, I should have thought that there was more propriety in it. The original plan was a survey of the coast, and a nautical survey based upon it. Such was the idea of Jef-

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ferson, and the idea of Gallatin, who, in his letter addressed to scientific men of the day, has as clearly delineated a geodetic survey as language can describe. Mr. Gallatin proposes—

1. The ascertainment, by a series of astronomical observations, of the true position of a few remarkable points on the coast. * * *

2. A trigonometrical survey of the coast between those points of which the position shall have been astronomically ascertained. * * *

3. A nautical survey of the shoals and soundings of the coast, of which the trigonometrical survey of the coast itself, and the ascertained position of the light-houses, and other distinguishable objects, would be the basis. * * *

Now, sir, if the basis of a nautical survey is the triangulation of the coast, then we had better refer the work over to the army than to the navy, if it is to be confined to one department; for they are more competent to make that geodetical survey which must be the basis of any useful nautical survey. If the purpose is merely to make a nautical reconnoisance along the coast, and make nautical charts, we have such now, made in our colonial existence. But, sir, of little value are they, without accurate determinations of latitude and longitude—without correct delineations of the coast—so that when the mariner approaches it he may recognise the prominent features that tell him with certainty where he is? It adds little either to the benefits of commerce or the navy; it adds nothing to science, positively nothing.

So far as I followed the Senator's argument, it was based upon the idea of the recurrence to a former law, and of producing economy and despatch in the work. Now, sir, as to the former law, the act of 1807 did not provide in terms for the use of the army and navy at all. So far from providing a plan to be executed by the army and navy, as the Senator's argument would lead one to suppose, it says nothing about the army and navy. It says that the President of the United States shall be, and is hereby, authorized to cause "proper and intelligent persons to be employed, and also such of the public vessels in actual service as he may judge expedient."

So far as the navy could be employed under this law, it must be constructively, from the use of the term "public vessels in actual service," which might apply to the revenue vessels as well as to those of the navy.

When Mr. Hassler was appointed superintendent for this work, one of his early difficulties was that the officers were not, technically speaking, under his orders; and after the work was discontinued and revived, Mr. Hassler, in 1832, wrote a letter which contained the clause that the Superintendent of the Coast Survey, the astronomer, or whatever he was called, should make actual observations in the field; that he should give orders and instructions to the officers of parties, and thus to guard against such a condition of things as had led to his former difficulty. It was to give him authority, and to avoid being reduced to the head of a bureau, instead of having an opportunity in the field to illustrate the science which he believed himself to possess. It was his ambition to be in the field, as it is that of the present Superintendent. He did not wish, as a mere bureau officer, as head of the department, to receive the reports of parties in the field. He wished to make astronomical observations, and to connect himself with the triangulation of the coast. These were not the terms imposed upon, but those sought by, Mr. Hassler, as a man of science. Has it been changed? Have there been any variations from the duties assigned to the Superintendent? If so, have they not been constantly increasing his field labors?

In the year 1832, when the system of 1807 was revived, we find distinct provision for the employment of officers of the army and navy. The President is authorized to "employ all persons in the land and naval service" for the survey of the coast, "and such astronomers and other persons as he shall deem proper." Now, the navy was specifically connected by law with the hydrograph of they survey. During Mr. Spencer's administration of the Treasury Departent anm

organization was adopted giving the Superintendent the powers which the present Superintendent now exercises. Did this constitute a bureau? If so, it was a bureau of Mr. Hassler's. But, Mr. President, can that be a bureau which is a mere temporary employment? This is a mere temporary employment, without a fixed salary, and without commission of office. The whole ground on which Mr. Hassler claimed a right to continue in employment was, that the terms of his letter being accepted, constituted a contract. It was not a bureau *then;* it is not a bureau *now.* It was an office then, to which reports were made for examination, and results sent for computation; it is the same now, and in the same building, as in Mr. Hassler's time. What change, then, has been made in the organization?

I said, Mr. President, that the duties discharged were of the same character; but they have become more extended. The present Superintendent passes about eight months of the year in the field, engaged in astronomical observations, in triangulation, in magnetic observations, in measurement of bases upon which triangulations rest. Last year he was in North Carolina, Maryland, and New Hampshire; and the year before he was in Massachusetts, Maine, Mississippi, Louisiana, and Alabama—thus stretching his observations over the whole breadth of the Union. Last summer he took the field long before the adjournment of Congress, and returned after Congress had reassembled. He left, I believe, in the month of April, and returned after the commencement of the present session of Congress. Mr. Hassler made but two preliminary and one actual base of operations. Now we are operating upon four distinct measured bases. The old plan might have been conducted with one astronomer, for it commenced on one base, and was extended north and south. No man living ever could have seen it completed. When it had passed a certain point, say three hundred miles, it would have been necessary to measure bases of verification. In the present system, these bases have been measured and made the original bases of other triangulations, and in time become also bases of verification. Thus the work is divided into different sections, and various parts of the coast—some of them very dangerous—are brought under early examination, and promptly the benefits of the work are conveyed to every portion of the Union, and the time in which it may be completed reduced. Now, we have nine sections; and just to this extent, if the appropriations are sufficiently large, may the time be divided in which it is to be finally completed. Had the present Superintendent desired merely to get his salary, had he consulted his own ease, he surely never would have extended the survey so widely, and divided it into various sections, giving him the increased and increasing mass of work which now devolves upon him; shortening the period, according to this plan, in which the work will be completed, and, therefore, the term for which he can hold the office he now fills under the present Coast Survey organization.

Let me not be misunderstood. These remarks are not intended to reflect in any way upon the late distinguished Superintendent, or to disparage his labors. In the language of the present Superintendent:

"The survey, which was suspended by the act of 1818, was revived by that of 1832. The preliminary operations of 1816 and 1817 were but partially available on recommencing the survey in 1832, from which latter period, therefore, it dates its effective beginning. The first years were necessarily years of organization and instruction. The Superintendent, Mr. Hassler, had to systematize methods, to train up assistants, to cause the work to grow from a small beginning until it comprehended the various operations of a geodetic survey of the coast and included its hydrography. When the results accumulated, it was necessary to provide for their computation and reduction, and the preparation of maps and charts upon a plan suited to our extended coast, and the engraving of the maps. All these things were new in this country. The amount of knowledge, skill, and labor required to overcome these and other difficulties were hardly appreciated. The results show how large an amount of work had been done, and how the work was extending beneficially at the time of Mr. Hassler's death."

"Building upon this foundation, it was easy for Mr. Hassler's successor to give further development to the work."

As to the economy of transferring this survey to the navy, I should think nothing can be more manifest than that if it was assigned to a single corps, the compensation of which, and reputation in its prosecution, was not derived from the work, it would lose in expedition and increase in expense. Not only has this result been proved by the experiment of 1818, but the same conclusion should have been reached by *a priori* reasoning. What interest would they have; what dread of examination; what regard for public opinion? They will have their pay and professional distinction as connected with the navy, whether the Coast Survey be approved or not, whether it be continued or discontinued. And if we refer to foreign services, where surveys are conducted thus, it will be found that the expense bears no relation to that of our Coast Survey. This is established by the reply of the Secretary of the Treasury, recently sent to the Senate. He estimates the secondary triangulation and topography by the ordnance corps in Great Britain, exclusive of officers' pay, at sixteen cents two mills per acre—between twice and three times the cost of our surveys of the same kind.

The Secretary says he had not sufficient data to make an estimate for the foreign hydrography. From other sources I find that the hydrography executed by Great Britain (I read now a manuscript note) cost in two years, 1845–'6 and 1846–'7, an amount equal to the whole appropriation of the coast survey of the United States from its beginning to the present time. In the ten years past, it amounts to five millions of dollars, and this is besides her Arctic and Antarctic expeditions; it is also besides her trigonometrical surveys. This Bureau of Ordnance and Hydrography is misunderstood, or as to England misapplied. The ordnance surveys of Great Britain have no connexion with the hydrographer's office or with the hydrographical surveys. The ordnance survey of Great Britain is a geodetic survey of the whole kingdom, carried on by the ordnance corps of the army. It has cost, in the same period, 1,500,000 pounds sterling, which is equal to about seven millions and a half of dollars. It has been in progress since 1791; and if we examine the cost officially reported, we are startled by the amount of expenditure which we meet. Economy, then, can be no inducement to exchange our system for that of Great Britain.

But it is said that the navy desires this work. It is said that they are mortified because the work is not confided to them. Now, Mr. President, what part of this work is professional to the navy? Can it be any part of the land work? Can it be the determination of latitudes and longitudes on shore? Can it belong to the seaman's profession to make topographical surveys? The hydrographical part of the work is now in the hands of the navy—is entirely confided to the navy. Why should we put officers and men of the navy upon other than that part of the work they are best able to perform? They are now engaged in surveying the shoals, marking their outlines, delineating the curves of soundings at equal depths, determining the limits and depths of channels, and the character of the bottom. These determinations are based upon the points accurately fixed by the trigonometrical survey of the coast itself. When the distance from the shore is reached, beyond which the sights from the shore cannot be extended, it becomes necessary to anchor vessels, and make them new stations of observation. All this work, and the observations of tides and currents, is executed by the hydrographic parties, composed of naval officers exclusively, under scientific superintendence.

If the navy, Mr. President, is (as has been said) unemployed; if there be any portion of it which ought to be employed on this Coast Survey, and is not, the Superintendent has provided for them. He has thrown his bases wide over the coast—has divided the work into sections. It therefore lies ready, as the coast is surveyed, for such increase of hydrographical parties as the naval ser

vice will permit, furnishing employment upon a scale which could not have been reached if the work had been continued on a single base of operations.

But what truth is there in the idea that the navy is seeking this work and cannot obtain it? Why, sir, there is now an application to the Secretary of the Navy for a hydrographical party for Charleston. The Secretary of the Navy may grant the requisition. I do not doubt his willingness to do so, if the interest of the service will permit it. But I have heard of his complaining of the frequent draughts by the survey on the navy.

The officers of the navy have shared fully the honors of the Coast Survey, having received full credit for the work executed by them. Where is the channel that has been discovered by them, that does not bear the name of the officer of the navy who discovered it? Where is the chart, that does not show the name of the officer by whom the hydrography was executed? I have not seen one. Gedney's name is indelibly associated with the harbor of New York, and that of Blake with the new channel in Delaware bay. I know of no reputation which the officers of the navy could gain from a work of this sort, higher than that which they now acquire as a part of this great system.

By attempting, as under the law of 1818, to combine topography, work not at all professional to the sailor, with the hydrography, credit was lost, not won. The Secretary of the Navy, Mr. Southard, in 1828, referring to the charts produced, says of them, that "they are unsafe, and in many instances useless and pernicious." There must be a system, organization, and connexion of the whole. In the emphatic language of Mr. Southard, "nor can such surveys be made without the aid of the means contemplated by the act of 10th February, 1807." Could this organization be obtained in any other way? Suppose an officer of the army charged with the conduct of the survey—would you require the officers of the navy to serve under him? If you place an officer of the navy in charge, then you must either take the highest rank in the navy, or confine yourself to those who are the juniors of your Superintendent. Here is at once introduced the jealousy of rank which does not exist under the present system. You lose, thus, the services of officers otherwise well suited to the work, and who, in independent positions, under scientific superintendence merely, would be glad to serve. This I think to be a very great drawback to efficiency. But there are branches of the naval service now filled by civilians, and some of them positions of very high emolument, which appropriately belong to the nautical profession. The naval officer should be able to build a vessel, and yet civilians are employed in this work. Engineers are employed, and some at high salaries, in building docks, &c. Steam engineers from civil life are also employed. Why should not the navy build the engines for their vessels, and direct the working of the engines which propel their vessels, as they would the sails? These are branches of the profession in which they can be employed, usefully and honorably employed, and which would not divert them from the proper pursuits of the sailor. But if an officer of the navy, of science and special information and rank, sufficient to carry on this great work, should be charged with it, how long would he continue in the post? An officer of professional enthusiasm, at the very first note of war, the first gun that comes booming over the sea, would disdain the functions of the savant. He would call for his sea-glass, instead of his telescope; his thoughts would be on the trunnions of cannon, instead of the pivots of observing instruments. His computing tables would be thrown from him, that his hand might grasp the sabre, and he stand with arms rattling about him, beneath his country's flag—upon his country's deck. If he would not do this, he would not be worthy to hold the station of an officer in the navy. Then, sir, in the hour of greatest need, he who had charge of the work would abandon it for service better filling hopes proper to his profes-

sion, and then you must seek a savant to superintend the work during war, and he must learn the organization of the establishment, under circumstances least favorable to instruction, and most demanding accuracy, activity, and efficiency.

But, sir, it has been asserted that our navy is idle and unemployed; that our present establishment is a war establishment; and that the annual appropriation of eight or nine millions, is therefore an expenditure without adequate return.

Is the navy idle? With even the small force which we keep in commission, our ships are in the four quarters of the globe, engaged in maintaining the police of the seas, and in vigilantly watching over the interests of American commerce. Their presence every where arms the functionaries of the Republic with greater consideration and power of usefulness.

Is the navy unemployed? If so, increase the number of vessels in commission, for we surely cannot have an excessive number afloat while our trade with China in so imperfectly protected; when we have not a single vessel on the coast of Sumatra; while our merchant marine and whaling fleet in the South seas ask in vain for the arm of the American navy to protect them, and enforce discipline in lawless and discontented crews; whilst our fellow-citizens abroad have again and again been indebted to the courtesy of British naval officers for services which their own Government is bound, by every consideration of justice as well as pride and policy, to render.

Is the navy on a war establishment? This is most easily answered by referring to the fact that even during the late war with Mexico, destitute as that country was of maritime power, authority was given to our Executive to increase the naval force during hostilities. With the restoration of peace this authority was annulled, and the navy reduced to its former narrow dimensions. There is enough, and more than enough, of appropriate duty for all the navy which we keep in commission. Let it then continue in its legitimate employments at home and abroad; not be brought from its ships to labor on shore in the solution of problems in geodesy and magnetism, which are not even cognate branches of a sea officer's education. The sea is the element on which they are to serve their country in war; the element on which they should be educated in peace.

I think the Senator is mistaken in supposing that our naval officers are chagrined or mortified at not being intrusted with these uncongenial operations of the CoastSurvey. They will, I doubt not, be far more gratified if he will extend the field of their labors upon the ocean, and open to them new roads to preferment in the line of their own profession.

The State by whose authority I am here, whose rights and interests it is my duty to guard and promote by all the power with which I am endowed, has much involved in the proper execution of this work, and she has claims of no common character to consideration for these interests. She has contributed without stint to support expenditures in other portions of the Union; she has seen the northern Atlantic coast the subject of special care, and rejoiced to see its harbors surveyed, its capes and islands crowned with fortifications, its shore glittering with light-houses and beacons, through storm and darkness to guide, to save, to welcome home, the canvass-winged birds of the ocean. But when she turns to her own coast, with winding channels and shifting bars and shoals irregularly presented, without charts of sufficient accuracy for the most common purposes of navigation, still less to determine where and how the hand of man may enlarge and render permanent the advantages of nature, has she not a right to demand, that this exact, scientific survey and investigation of her channels and shoals, and the great causes which may hereafter, as they have in times past, disturb and alter the one or the other, shall progress to its completion; shall bring to her door this the first contribution by the General Government to her commercial interests and maritime defence? Already this survey

has made important additions to the knowledge of our gulf coast; channels have been explored and delineated; new means of approach secured; the points for lights thus properly determined; the fact of changed depth in some of the most important avenues of commerce discovered and published; and now, when all seems hastening to a healthy maturity, shall we fell the tree with its unripe fruit to plant another, the product of which no one will contend can be better?

The interest of those whom I represent has prompted me to an examination more than ordinarily full of the organization and progress of the Coast Survey. In both I have found much to admire, of efficiency, economy, and order. Years of experience and patient toil, under men bounteously gifted by nature and rarely favored by education, have brought the system to its present state of perfection. Could I see where a pillar, a prop, a brace, a key, or a pin was wanting to the fabric, I should have pride in attempting to supply it, in coming to the aid of those past and present to whom the merit of construction is due.

We have been referred to the increasing appropriations for the survey of the coast, and this unconnected fact has been presented for the purpose of attack upon the conduct of the work. The value of the fact depends upon the relation of expenditure to product.

And now, Mr. President, what has been the result since the present Superintendent took charge of the work? Five years have elapsed since his appointment, from which to gather an answer to the inquiry. It is due to the memory of the former eminent superintendent, that we should recollect that he took charge of the work when in its infancy. That it was necessary for him to organize the survey, to train up assistants, and to make a beginning in the introduction of geodetical science into our country. But what have been the comparative results?—for economy is not to be measured by the thousands of dollars provided in any one appropriation, but from the return for money expended.

In the letter of the Secretary of the Treasury, before referred to, we find that the expenditure for twelve years—1832 to 1844—under the superintendence of Mr. Hassler, was $766,134 18, the annual appropriations ranging from $20,000 in 1832, to $100,000 in 1843, as the work became organized and developed. The expenditures are less than the appropriations. The expenditure from 1832 to 1844, is $766,134 18; from 1844 to 1849, $579,250 32; the expenditure of money, as seven to five; time, as twelve to five. The work done in the last five years exceeds that in twelve preceding years. If in less time for less money greater results are obtained, shall we complain of increased annual expenditures? Is not this economy? Surely, sir, no one will contend against an appropriation which hastens to completion a work which is more valuable as earlier completed. It is said this Coast Survey will not be brought to a close in forty years. Upon what calculation does this assertion depend?

The length of our shore line is estimated at twenty-eight thousand miles. It is certainly beyond that, because there are indentations of the coast not shown on the charts by which we estimate. Now, the work done in the year 1844, compared with the work of 1848, will be about as one to two. The average of the last five years as 1½ to 2. Upon this, then, we have the basis of a calculation as to when the work will be finished. The average, then, of the last five years is, to the work of 1848, as one and a half is to two; one-seventh of the coast, reckoning on the same maps from which the total shore line is estimated, has been triangulated in the last five years; in the next five years, at the same rate, we would achieve three-fourteenths—fifty per cent. over the latter. Then, in fifteen years, we should have finished nine-fourteenths; making, with one-third already accomplished, within a very small fraction of the whole coast. I do not say that in fifteen years we shall have no need of the Coast Survey, and that it is then to close. And more, sir, I hope it will not. In its progress, the parts of the coast which

are liable to change will have become definitively known, and the work may then be employed in ascertaining the changing of the shoals and shifting of the channels, necessary to the benefit of commerce. Besides, sir, I hope to add yet further to our coast. I would be glad to include the shores of the Gulf of California as those of one of these United States. I should be glad to gather in the Island of Cuba, so long desired. I should rejoice in the extension of our Union. I therefore speak of this term only as indicating the progress of the work; the time at which the survey of the coast on the Atlantic and Gulf of Mexico would be brought to a close at the present rate of progress. But, sir, our laws have been extended over a portion of the coast upon the Pacific, and we have made appropriations for building light-houses and placing buoys at the mouth of the Columbia river. To determine the places of these is an appropriate and necessary hydrographic service of the Coast Survey, and to commence the survey there, and render this service, parties have been despatched to the coast of Oregon, and not, as has been falsely stated in some of the papers, to California and New Mexico.

For the hydrographical survey a very accomplished officer of the navy was selected, and an able party was placed under his orders; for the survey of the shore, a party of civil assistants and officers of the army. It is worthy of remark, sir, that when the present Superintendent took charge of the Coast Survey, he found that the officers of the army had abandoned the work—had become dissatisfied—and the Secretary of War had refused their aid on the terms upon which it was asked. The present Superintendent, by avoiding a controversy which grew out of the requirement that the land parties should be equally divided between civil assistants and officers of the army, and by the judgment which he brings to bear on everything, has been able to draw them back to the work. When the war with Mexico broke out, he had eleven officers of the army thus employed; eight of them were taken away. He has applied for topographical engineers since the termination of the war—an application which has been laid over for the present by the chief of the Topographical bureau, until he can determine whether officers are disposable from the other wants of that department. An application is now pending before the Secretary of War for officers of the line of the army to aid in the survey of the coast. In the last report on the Coast Survey to the Secretary of the Treasury, the Superintendent expressed himself upon this particular point. He says:

"The number of officers and petty officers and men are regulated by the same department, on application from the officers of the navy commanding the hydrographic parties. These are transmitted through the Superintendent and Secretary of the Treasury as a matter of form; but the judgment of the officers is conclusive with me, and the requisitions are complied with or denied, at the pleasure of the Secretary of the Navy. The law requires that as many officers of the army and navy as practicable be employed on the work; and, independently of the desire to husband the direct appropriation, which I confess is a strong motive with me, and of the respect which I feel for the officers of both branches of the service, and of the gratification which official or private intercourse with them always gives, I am bound by the spirit, and even by the letter of the law, to apply for additional officers whenever they can be usefully employed on the work.

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"Under the law, the organization of the Coast Survey contemplates the employment of civilians and officers of the army and navy. This triple organization brings the scientific and practical training of civlians and officers of the army and navy to its aid; a more permanent nucleus is supplied from civil life than the wants of either the military or naval service could yield, while entire concert of action is secured under a central authority, the department in which matters pertaining to the trade, commerce, and navigation of the country centre, in the name and by the authority of which the Superintendent acts. The scientific details, which careful study and the action of many minds viewing them from different points have matured, are made uniform throughout the work, and the whole proceeds according to a regular plan, carefully arranged, and having in view a definite result. The temporary character of the work is recognised as a cardinal principle, no permanent corps being organized to conduct it—a feature which has proved important in other works, and which, I doubt not, has its influence in this. Free scope is afforded for selection from the science of the country at large, or from either

branch of the military or naval service, under the heads of their respective departments, of those whom ability, knowledge, and opportunity unite in recommending for the service.

"As soon as the arrangements of the army in its new positions permit, I hope again to have the services upon the work of such of the staff and line officers as can be suitably employed, and can be spared from their regular duties."

That is his application of the law—such his desire to have officers of he army and navy seeking for more than he is able to obtain.

The Senator has referred to an article in the plan of organization of the Coast Survey of 1843, which requires that chiefs of parties detailed from the army and navy should not be relieved from the work without notice to the department having charge of it, and this, he says, puts the entire army and navy under the Secretary of the Treasury. The Senator surely must be aware that the Secretary of the Treasury has no power to detail an officer of the army or navy for the survey, but that is done by the head of their respective departments. Nor can it follow, as a legitimate construction of the article, that the department having charge of the work could refuse to allow an officer of the army or navy to be withdrawn by the head of the department to which he belongs, but only that notice shall be given, that the Secretary may not be embarrassed by the withdrawal of the chief of a party, without an opportunity having been given to supply his place and to provide for the prosecution of the particular work of which he may have had charge. Still more strange is the construction which would place the "*entire*" army and navy under the control of the Secretary of the Treasury, from the employment of a portion of it in the survey of the coast.

The investigations involved in the Coast Survey are of the most abstruse science, requiring computations of the highest order of mathematics and physics, such for example as the problem indicated by La Place in the Chamber of Deputies in 1817, and which has received its first solution, for the pride of American science be it remembered, by the present Superintendent of the Coast Survey. To determine the curvature of the earth, its exterior form, by the deflection of the plumb line, indicating the internal structure of the earth. This knowledge is essential to the exact determination of latitude, and therefore coupled most usefully and directly with the establishment of stations and with the accuracy of the survey. If there be officers of the navy, then, competent to this high reach of science, and, therefore, to superintend a geodetic survey, why do we not employ them to teach in the naval school? Why do we employ civil professors to teach midshipmen the elements of science? That seems to me far more professional than to undertake a work where the observations are astronomical or terrestrial—and the computations are for trigonometrical or topographical surveys, which can have no connexion with their profession.

I do not know how far the navy complain of not having their full share of this work. You will always find persons in the navy, as in other pursuits of life, complaining of their lot as compared with that of their neighbors. Many are no doubt anxious to go to the Mediterranean—anxious to go to the Pacific, and to take command of mail steamers. Two of them have left the Coast Survey for this purpose very recently. All desire the most eligible positions, and but very few in any vocation are ever content. My acquaintance is very limited with officers of the navy. My conclusions are derived from the few, but are very decided that in this, as on more memorable occasions, they are ready to co-operate with the army and share with them the good and evil. One of them—at this time an assistant in the Coast Survey—who is an honor to his profession, and who, if there be an officer in the navy competent to take charge of it, is, I doubt not, the very one—always commends in the highest terms the present organization of the Coast Survey. He takes every proper occasion to place in bold relief the successful labors of the Superintendent,

and would most deeply regret to see him driven from his position, even for the benefit of an officer of the navy.

I am anxious, Mr. President, to pass over these points as rapidly as possible; but I cannot neglect the statement which has been made of the existence of a bureau of ordnance and hydrography in connexion with the surveys Great Britain. The surveys made by the ordnance corps of Great Britain correspond very nearly to those made by our topographical corps. Their ordnance surveys are like our topographical surveys. Their hydrographi cal bureau is for hydrographical surveys; and by not having the two connected, it follows that the ordnance corps establish their stations, make their topographical survey, and then the hydrographical party must establish their stations also, upon which their hydrographical survey is based. The stations being independent one of the other, each must take independent observations, which perhaps never correspond, and produce disagreeing maps of the same localities. The Senator says we have a bureau of ordnance and hydrography, but it is for very different purposes from those which he seems to attribute to it. It is to supply naval ordance and munitions, to keep and issue nautical charts and instruments for vessels of war.

I have referred already to the expenditure of the ordnance survey of Great Britain; I will refer very briefly to their hydrographical surveys. I find for 1846, coupled with the hydrographical surveys, there are reported eighteen vessels, and these vessels of large tonnage—a large number of officers on board—a great many of them steamers—making the total tonnage upwards of 6,276. On the coast of England they have nine vessels, amounting to 3,201 tons, with sixty officers.

Vessels.	*Tons.*	*Stations.*	*Officers.*		
1. Beacon,	378	Mediterranean,	12		
2. Blazer,	527	Harwich,	7	(steam)	1
3. Bonetta,	319	Mediterranean,	6		
4. Columbia,	361	North America,	6	(steam)	
5. Dasher,	260	Portsmouth	7		2
6. Firefly,	–	Irish Channel,	7	(steam)	3
7. Fly,	485	East Indies,	12		
8. Herald,	500	Pacific,	10		
9. Lucifer,	387	Coast of Ireland,	7	(steam)	4
10. Pandora,	319	Devonport,	5		5
11. Philomel,	360	S. E. coast of America,	8		
12. Plover,	–	East Indies,	5		
13. Porcupine,	382	River Thames,	6	(steam)	6
14. Janarang,	500	East Indies,	12		
15. Shearwater,	343	Coast of Scotland,	6	(steam)	7
16. Sparrow,	160	Coast of Scotland,	5		8
17. Tartarus,	523	Coast of Ireland,	10	(steam)	9
18. Thunder,	472	North America & West Indies,	8		
	6,276		139		

On coast of England, 9 vessels, numbering 3,210 tons, and with 60 officers.
On coast of United States, 8 vessels, numbering 1,732 tons, with 49 officers.

This is the great establishment upon which their surveys rest, extending far beyond their own coast, at an expense such as is always to be found wherever the work is turned over to a corps or a profession not dependent for either its reputation or support upon the achievement of the work.

In relation to the amount which has been stated of the expenditure made by the navy for the benefit of the survey, I have taken the trouble to collect some facts. I find that the Secretary of the Navy, in reply to an inquiry growing out of the call of the Senate as to the expenditure made from the navy for the benefit of the Coast Survey, stated it to be $192,000 since 1844. This does not include the pay of the officers of the navy, which they would be entitled to if on leave of absence, but the difference between the leave of absence and sea pay, as the only amount which can properly be chargeable to the Coast

Survey. If it be supposed that they would not be on leave, but waiting orders, the amount would be less. The case therefore presents it in a most unfavorable form.

We find that the vessels employed were four schooners belonging to the navy; the rest either belong to the Coast Survey, or have been turned over from the revenue marine. The whole charge, therefore, which can be represented as an unseen contribution from the Navy to the Coast Survey, is the use of four schooners. It will be recollected, Mr. President, that for the revenue service we built some steam vessels, and they were found wholly unsuited to the service; and after the most expensive, fruitless experiments, they have been turned over to the coast survey; and running at low rates of speed, they have been found to answer a very good purpose.

The great expense of these steamers, their inapplicability to revenue purposes, and the expensive repairs constantly required, rendered it desirable to the treasury to get rid of them. In the Coast Survey they require few repairs; the consumption of fuel is very small, and a saving by transferring these vessels from the revenue marine, and substituting sailing vessels, as stated by Captain Alexander V. Fraser, will be from three to four hundred thousand dollars. So that the treasury has lost nothing by transferring these vessels to the Coast Survey.

The Senator from Missouri (Mr. BENTON) used a table. (I do not know where it was obtained.) It makes an exhibit of the annual expense to the navy of the hydrographical department of the Coast Survey, and of the number of vessels employed therein by Professor Bache. In this table, it appears, there are two hundred and nine thousand dollars annual expense to be charged to the Coast Survey, which was drawn from the navy. Now, sir, I do not find that the vessels here stated are used in the hydrography of the Coast Survey. It does not appear that some of them have ever been there. The officers, stated to be ninety-four in number, are actually forty-nine The "Jefferson" has never been used in the Coast Survey; the "Gallatin" has been transferred from the Coast Survey to the revenue service temporarily in exchange for the "Ewing." Several of the vessels, viz., the Phœnix, Wave, Vanderbilt, and Walker? [Gerdes] are employed by the triangulation and topographical parties, and are sailed and manned exclusively at the cost of the Coast Survey. The cost of fuel and oil and contingencies, is paid from the Coast Survey appropriation. It is not too much to say of this table that not one of the ten columns which it contains is correct. Its erroneous character will appear from the following tables:

List of the vessels used in the hydrography of the Coast Survey in 1848.

Names.	Class.	Where employed.	No. of lieutenants.	Passed midshipmen	Clerks.	Total.
1 Bibb.....	Steamer (schooner)	Nantucket shoals.....	3	2	1	6
2 Gallatin.....	Schooner.....	Nantucket shoals.....	2	2	1	5
3 Nautilus	Schooner.....	Long Island Sound and south shore of Massachusetts	3	3	1	7
4 Petrel.....	Schooner.....	Hell Gate and New York harbor....	1	2	1	4
5 Washington....	Brig.....	Chesapeake and outer coast of Md...	3	5	1	9
6 John Y. Mason.	Schooner.....	Chesapeake and North Carolina.....	1	3	1	5
7 Legaré.....	Steamer (schooner)	Gulf stream and off-shore Long Island	2	4	1	7
8 Walker.....	Steamer (schooner)	Mobile bay and Mississippi sound...	2	3	1	6

NAMES.	Number of officers stated in table of Senator from Missouri to be employed in hydrographical parties.	Number actually employed in 1848.	Error.
Legaré	10	9	1
Bibb	10	6	4
Walker	10	6	4
Jefferson	10	0	10
Washington	6	9	3
Ewing	6	0	6
Gallatin	6	5	1
Nautilus	6	8	2
Phœnix	6	0	6
Wave	6	0	6
Vanderbilt	6	0	6
Walker [Gerdes]	6	0	6
Petrel	6	4	2
	94	47	47

Error 50 per cent.

There are errors in the table in the number of vessels and the number of officers employed, making an expense of $209,000 for *one* year, when, by the report of the Secretary of the Navy, it appears that in *five* years it was $192,000—that is, in five years it was less than the amount stated here for one; or, if you include the whole pay of the officers of the navy, it will be $335,000 for five years, as shown by the auditor's statement to the Secretary of the Navy. Thus it will be about $67,000, instead of $209,000, per annum. At any event, the error is very great.

Official statement of the Fouth Auditor, showing the amount of difference between the sea-service pay and leave-of-absence pay of the officers of the navy engaged in the Coast Survey, from January 1, 1844, to December 31, 1848, the value of their rations, the pay of the crews of the vessels employed on the said service, and the value of their rations for the same period.

Sea service pay of officers subsequent to January 1, 1844	$207,584 25	
Estimated leave pay for the same period	142,757 16	
Difference	$64,827 09	$64,827 09
Rations of officers for the same period		11,998 60
Pay of crews		81,953 00
Rations of crews		33,886 00
Total (five years)		$192,664 69
Note of entire pay estimated at highest rate, or sea-service pay, (five years)		$207,584 25
Rations		11,998 60
Pay of crews		81,953 00
Rations of crews		33,886 00
		$335,431 85

Connected with British hydrography, "in the four quarters of the globe," instead of ten, there appear to have been, in 1846, eighteen vessels, at an expense of £178,000. The question asked by the committee of the House of Commons of the chief hydrographer was in relation to his assistants in the bureau, who had no more to do with the surveying than the clerks in any other bureau. The surveys are made by naval officers, and the number of officers

employed is not indicated at all by the amount of money expended, which is over and above their navy pay.

The following is a table of the expenditures for hydrography from 1837 to 1847:

Hydrography of Great Britain and Colonies.

1837-'38	£68,517
1838-'39	59,202
1839-'40	58,862
1840-'41	52,517
1841-'42	91,832
1842-'43	142,235
1843-'44	134,126
1844-'45	126,583
1845-'46	178,782
1846-'47	123,678

In the last two years an amount equal to the whole Coast Survey appropriation, and in ten years five millions of dollars. This is besides her arctic and antarctic expeditions; and besides her trigonometrical survey, which, from 1811 to 1847, cost £1,500,000.

The amount of expenditures for pay of officers and men employed in the hydrography of the Coast Survey, and which I have stated above, is to be found in the reply of the Secretary of the Navy to the Secretary of the Treasury—a document which I am sorry is not printed and in the hands of every Senator.

The salary of the Superintendent has been referred to; and the whole answer to that is, that no salary has ever been fixed by law. It is a temporary employment. The annual compensation originally made to Mr. Hassler has been continued to the present day. When he resumed his work in 1832, there were about four years—perhaps five—when the amount of $1,500 claimed for superintendence of Coast Survey and weights and measures was not paid him. In 1836, however, the terms of the appropriation bill referring to the Superintendent were used, and considered as covering the back pay, and the back pay of $1,500 per annum was given to him. His compensation to the close of his life was $6,000 per annum. The same rate has been continued, dollar for dollar, to the present Superintendent. There has been no change in the compensation. The duty has changed only by increase of the time in the field. He still retains, under the same organization, the same amount of compensation. It can be varied by the President at any time. As this might cause the present Superintendent to leave the employment of Government, it would be a serious evil, and in which the country would lose far more than the Superintendent. In justice I should state, that the researches on hydrometers for the revenue, and on sugars, have been superintended gratuitously.

But the next position taken was, that these observations concerning latitude and longitude were invading the proper duties of the National Observatory. Now, Mr. President, two observatories since the establishment of the telegraph wires may determine difference of longitude with great accuracy. But, how a fixed observatory is to determine the latitude of other places, I am wholly at a loss to imagine. The observatory can fix the stars; but, unless it is made locomotive, put upon wheels and carried over the country, it can have no power to determine the latitude and longitude of places. But this observatory is to be made the receptacle of the Coast Survey, instead of transferring *it* to the Coast Survey—the minor to the major part. * * * * *

And is it reasonable, sir, that this observatory take charge of the determination of the latitude and longitude of stations on the coast, those observations upon which all primary triangulations of the Coast Survey must necessarily rest? Shall they wait until this observatory can go over the country and determine the

latitude for them? The Coast Survey has employed observatories, as far as available, to make astronomical observations for stations: thus it could be done better than in temporary buildings, and at one-fifth the cost—that is, for about $200 a year; whereas it would cost about $1,000 to erect temporary observatories and provide observers. It is economy, then, to use these observatories; and when the law prohibited the construction and maintenance of an observatory by the Coast Survey, I can not conceive that it prohibited the use of observatories, so far as it contributed to the objects and economy of the work.

It was to avoid, I suppose, connecting the Government with the establishment of such an institution, and its maintenance, that the prohibition was made. When, sir, observatories are erected and maintained, and offer facilities for observation, surely it could not have been designed to forbid their use for temporary purposes. If it was astronomical observations which were to be excluded, why then, sir, authorize the appointment of an astronomer? If astronomical observations are to be made, surely they should be made under all the circumstances which give the greatest accuracy. Nor is it material, so far as accurate determinations of *longitude* are concerned, whether this observatory be upon the coast or far in the interior; all that is required is, that the line of a magnetic telegraph should pass through it, and the observatory at Cincinnati is as available for determining the longitude of New Orleans, Charleston, New York, Boston, or Portland, as a similar establishment at either of those stations of the coast.

The advantages, Mr. President, of a mixed organization for conducting the Coast Survey are fully shown by the working of the present system. The army and navy are brought together by a harmonizing link, a head not supposed to be prejudiced in favor of either the one or the other. The Superintendent of the whole lays down the plan, presses his land survey in advance of his hydrographical survey; and while the hydrographical survey, by observing points upon the coast, will test the accuracy and emulate the land parties, there can be no rivalry other than a generous one; there can be no jealousy between the two arms of the survey, no conflict of rank between the assistants and the savant who has charge of it, and binds the whole together by the fraternizing bands of science. The results are seen in the good feelings which have existed in the operations of this work, so far as I have learned, justifying fully the wisdom of the plan which was adopted by that Secretary of the Treasury who took the deepest interest in this matter, and who was the best qualified, probably, since Mr. Gallatin, to perfect the organization of the work. I now refer to the plan of 1843, and the regulations of the Hon. John C. Spencer. From that time to this it has continued. It is carried on now exactly under the organization of the original establishment, as modified by the regulations of 1843 and 1844; the Superintendent operating more constantly in the field, being about three-quarters of the year in open air, living in tents and schooners, making his observations, measuring his angles, measuring with still more wonderful accuracy the bases upon which these observations rest. It was fortunate, sir, that this work, when it lost its founder, was transferred to its present Superintendent—a man who, to the severest early training in science, combined simplicity, purity of character, and strict utilitarian principles, which he has always brought to those subjects intimately connected with the work. No wandering after vague problems, no seeking idle reputation by the discussion of questions which, however abstruse, were unconnected with the purposes before him; always intent upon the object—a survey of the coast—and to execute it according to the spirit of the law. He has brought his topography nearer to the coast, extending no further than the first high land or road, so as to limit it to the most narrow compass which would answer every purpose of navigation and coast defence.

Defence is certainly very intimately connected with the purpose of coast survey. Had Long Island been surveyed, and had we possessed a map of it during the revolutionary war, the difficulties which General Sullivan encountered would never have occurred. His letters to General Washington state that he was ignorant of the country. That want of knowledge of the country caused one road, which he did not know, to be left open. The enemy, informed of it, turned his position, made a feint in front, a real attack in rear, and defeat followed. The disaster which befel the army was the result of the want of a topographical map of the island.

And again, sir, to refer to the same period and locality. Had the bay of New York been known as well then as now, Count d'Estaing would have passed with his vessels of war into the harbor, and would have found the British without the power of effective resistance. Want of knowledge of that channel by the pilots sent to the French fleet, induced their commander to abandon, as a hopeless object, an entrance where there was really sufficient water for the draught of his vessels. These are two great facts, and present their own application.

Now, sir, as the most minute accuracy is required in topographical maps to serve for military operations, anything which improves their exactness or legibility is important. I saw, in the office of the Coast Survey two maps of New London and its vicinity—one of 1840, the other of 1847. In the first, two streams emptying into different bays had been considered one, and the officer who should have landed upon the coast and projected his operations by the first map would have fallen into a fatal error; and if in presence of an adversary better informed than himself, must have been defeated.

Nothing, sir, could have been a greater error than to suppose that the present Superintendent of the Coast Survey would prefer to be a bureau officer; he is a man of science, a practical astronomer—delights in the days and nights passed in the field of observation. If an attempt was made to reduce him to the condition of a mere bureau officer, he would assuredly resist it.

Shall it be objected, sir, to this Coast Survey that it has attained the highest scientific character, at home and abroad? That is with me a great object of pride and of gratitude. Nor, sir, has there been one scientific discovery, so far as I have been informed, upon the Coast Survey, which has not had direct and almost immediate application to the work. The bars for measuring bases give a good illustration of this. It was found that the best compensating bars which existed were liable to unequal expansion by heat during change of temperature. The compensating bars are of brass and iron, and these two metals have unequal capacities for heat and unequal conducting powers. In the base apparatus, made by the present Superintendent, under his orders, the bars are so proportioned in mass as to heat in equal times, the surfaces being covered by a varnish so as to render the absorption at the surface the same, or nearly so.

In former base bars, when the temperature was rising or falling, it was found that one would absorb heat more rapidly than another, and thus produce a variation in the length; whereas it should be constantly the same at all temperatures. To the present Superintendent of the Coast Survey, it is due to say, that he has brought this problem to a complete solution. He has, by changing the mass of one or the other metal, in a certain proportion, obtained a constant expression of length, with the exception of a small residual error; and he has even corrected that minute residual error, which had been shown by experiment still to exist, by the use of different pigments, so as to increase the absorptive power of one of the metallic surfaces. The equilibrium is now so perfect, that in a base six miles in length the maximum variation has been found from experiment to be so small a fraction that I fear to state it—I believe it is less than five-tenths of an inch.

He has also introduced another great improvement, namely, the process of electrotype multiplication of plates for the printing of the charts without wearing out the original engraved plate. It is a most beautiful application of an invention which only men of science could ever have understood, and still less have improved to actual use.

The remark has been criticised, though I think it was well said by one of the most distinguished assistants of the Coast Survey, that it has its mission of science; and happily has this mission been connected with useful purposes in this survey. When sounding for deep channels and samples of bottom, the earth was found to be filled with organisms; and when naturalists observed that different organisms were found in the different depths of the sea, as different animals at different heights of the land, one would hardly have seen how immediately this was to be connected with navigation; and yet it has been so far followed out, as to give good reason to believe that we shall find families to be classed below as above the great level of the earth; and that, finally, a hydrographic chart may be constructed which shall give us, by the nature of the organisms, a new mode of determining the longitude of the vessel as she approaches the coast. The latitude is always most easily determined by a vessel at sea; and if the longitude can be ascertained, the position is exactly known. If this can be learned, therefore, from the appearance of the bottom, by the aid of the lead, a great portion of the danger in approaching the coast is obviated. But the captain is relieved from the apprehension of any errors when he sees the whole line of coast before him, as presented in its bold topographical character, so as never to be mistaken.

By constant soundings of the sea, charts of the bottom so accurate may be made as to enable the vessel, when she approaches the shore, by the lead, to inspect the ground over which she sails, as by the glass to examine the appearance of the coast. These elements, added to observations for the latitude, determine the position without the possibility of a doubt as to the shore she is upon, what coast she is approaching, what channel she is in.

It is always a high astronomical problem to discuss the tides, and currents dependent upon the tides. This problem is now in the progress of a solution, which will throw new light upon this subject, and give an additional advantage to commerce which could not have been otherwise derived.

In a particular part of the main ship channel in the harbor of Boston, for example, this singular phenomenon is presented—that there is but one quarter of the ebb tide in which the current sets out of the harbor. In all others the current runs in, ebb or flow. So that a vessel passing out to sea on the ebb would, on reaching this part of the harbor, find the current adverse. These are facts which, though of great value to the mariner, it requires careful and well-directed observations to explore. The whole system of observations on tides and currents in the Coast Survey has been greatly improved, and the mode of discussing the observations brought to considerable perfection.

Then, too, sir, systematic observations have been made upon that great phenomenon of our continent the Gulf stream. It is somewhat remarkable that Doctor Franklin, about the year 1760, first observed the change of temperature in that Gulf stream, and indicated its application to useful purposes of navigation; and that it now falls upon his descendant, and one worthy to be a descendant of him whose common sense taught him the most difficult lessons of philosophy, and placed him in advance of the age in which he lived; whose science was of that daring kind which brought Jove's bolts from his charged battery, and held them by a silken string; so useful, that it lives on the cottage roof and in the parlor fire-place; so permanent, that his name is known where wisdom is honored and virtue respected—somewhat strange that this problem, first marked out by him, should descend, for its solution, to the present Superintendent of the Coast

Survey, the great grandson of the original discoverer, and that the most extensive observations should have been made by a brother of the Superintendent, a gallant sailor, who, devoted to the honor of his profession and the duty in which he wasengaged, lost his life in the exploration of the character of this phenomenon, and left behind him labors which have not yet been properly appreciated.

Here is another element by which to determine the longitude of vessels approaching our coast—the temperature of the water. When the line which separates the cold water near the coast from the hot water of the Gulf stream, shall have been accurately laid down, the approximate longitude will be known by an observation of the thermometer. This requires careful and repeated observation to fix the limits of change of temperature by season and in different years. The high temperature of this ocean stream, and its ceaseless flow, render its position of primary importance to the navigator near our Atlantic coast.

I must not, Mr. President, dwell upon the great number of discoveries of channels, sunken rocks, shoals, and bars, every one of which may, in a single hour, save to the commerce of the country more than the whole Coast Survey has cost from its commencement. Many of these shoals, if accurately laid down in previous nautical charts, would have saved the wreck of vessels; by which, from the mere duties upon the goods wrecked, we lose more than would have been sufficient to furnish a complete survey of the portion of the coast where these disasters occured.

The maps are in rapid progress of publication. The present Superintendent has issued twenty-one distinct maps, and a large number of copies have been printed and distributed, a number of preliminary sketches have been prepared, to give the earliest information to the public, to show a channel or harbor useful to navigation and beneficial to commerce, or a shoal or rock to be avoided.

Now, Mr. President, after this long term of years, and when this minute examination of the coast has been extended continuously from the southern limits of Maine to the northern limits of Virginia; when the work is going on in seven of the nine sections into which the coast has been divided; when five bases have been measured, and the work is progressing in every State but one on the Atlantic and Gulf of Mexico; when we of the extreme South, who have contributed to its support, are about to derive some advantage from it, what justice is there in abandoning it, and going back to the exploded scheme of a nautical survey, which has once failed to furnish such maps and charts of the coast as we require? I have the evidence before me from insurance companies, chambers of commerce, scientific associations, all bearing the highest commendation to the mode in which it is now conducted. (See appendix.) It has been submitted to the closest scrutiny of scientific men, and has obtained their approval. Then, sir, I ask, can we abandon a work bearing such useful fruits, fruits so honorable to the commerce of the country, at a time when its abandonment would operate so unequally to different portions of the Union, and resort to that which has been tried, fully tried, and which has been found to contain the inherent element of its own destruction?

Mr. Benton, * * * *

Mr. Davis, of Mississippi. A question has been asked which I feel disposed to answer before the adjournment—the question whether the navy is, in fact, incompetent to conduct the hydrographical survey. The answer to this is, that they do conduct it, and nobody else conducts it but the navy. The whole of the portion of the work which is professional to the navy is confided to them. The only difference between our survey and that referred to, of England, arises from the fact that the navy conducts our hydrographical survey in connection with the trigonometrical surveys. Of course, instead of being compelled to make their own observations, and to fix their own stations upon which

to base their hydrographical observations, they derive their points and shore line from the land parties; this is the economy of our organization. Surely it is no discredit to the navy to suppose that those who are trained to topographical labor upon the shore would execute it better than those whose lives are spent upon the waters, and whose profession is upon the water. The work upon the land is not appropriate to them; it is not their own element; and I cannot believe that any proud sailor of the American navy would wish to rival an officer of the army in topographical survey, or to rival the *savant* in the computation of astronomical phenomena, or in the making of astronomical observations. It is not his profession. His pride is in his profession. His glory is to be gained there, and the laurels which now crown the navy, and endear it to every American heart, have been gathered at sea in the face of the enemy. Hydrographical surveys are usefully and properly executed by the navy in time of peace. They constitute a school in which the American sailor is instructed, and prepared for the high contingencies of war. In referring to the work on land as the more appropriate duty of the army officer, I make no invidious comparison between the naval and the army officer. I make no reflection upon the talents of the officers of the navy. This is not the work of talent. It is the work of training, of preparation, of close study, of extended science—such as the officer of the navy cannot acquire at sea; and if his early life were to be devoted to such studies on shore, his nautical experience must necessarily be very limited—his character as a sailor sunk in exact proportion as his character as a *savant* rose. I should dislike very much to see any prejudice or jealousy excited in the navy; there is no necessity for it. Instead of reducing their professional pride, I desire to exalt their ambition in those things which are entirely professional to them. I attempted, to-day, to point out new fields in which they may be employed.

I did not certainly intend to cast any reproach upon Mr. Hassler. On the contrary, if I was not complimentary to him, I intended to be so. If I did not state as a reason for the difference in the progress of the work under the former and present Superintendent, the embarrassment to which he was subjected, and the difficulty of organizing a new work under a new system of which he was the founder, I failed of doing what I intended. It was my intention to draw no invidious comparison. I was comparing—not appropriations—the Senator mistook me there—but expenditures; not the money appropriated, but the money actually expended—dollars, years, and work. Mr. Hassler organized this work. The present Superintendent took it as he found it.

I cannot allow this occasion to pass, sir, without again saying that I made no invidious comparison. In defending an organization which I considered essential to success in the Coast Survey, I compared, as I considered it my duty, the expenditures, the time, and the labor. I attempted to show that the work was progressing rapidly, and even went out of the appropriate line of my argument to guard against being misunderstood as disparaging the works of the former Superintendent, to point out the disadvantages under which he labored. It is to me a matter of pride, sir, that the reflection once made that no American could be found to take charge of the work, has proved so untrue. An American has been found, who has not only been able to discharge the duties of his office, who has not only been able to keep pace with science, but who has been foremost in some of the most difficult investigations, and has attained results for highly useful application to the necessities of commerce and the perfection of the work with which he is charged; often passing before, never falling behind, the improvements of the age, he has elevated our scientific reputation abroad, and is at home justly the object of American pride.

APPENDIX

TO

Speech of Hon. Jefferson Davis, of Mississippi, on the Coast Survey, delivered in the Senate of the United States, February 19, 1849.

REPORT *of a Committee of the* AMERICAN ACADEMY OF ARTS AND SCIENCES *of Boston and Cambridge, on the United States Coast Survey, unanimously adopted at a meeting held February 6th*, 1849.

[Communicated by Dr. Asa Gray, Corresponding Secretary.]

The committee of the American Academy of Arts and Sciences, to whom were referred the reports of the Superintendent of the United States Coast Survey, and also the letter of the Superintendent requesting the opinion of the Academy thereupon, respectfully submit the following report:

The present Superintendent of the Coast Survey of the United States was designated in 1843, with extraordinary unanimity, as the proper successor of Mr. Hassler, by the science of the whole country. It was believed that his great scientific capacities, nurtured at West Point, and grown to maturity under the most favorable opportunities for development in his own country and during his European travels, united with his admirable judgment and enlarged administrative ability, were precisely adapted to the conduct of this national work, so important to commerce and navigation, and so interesting to science. After the lapse of five years from the date of his appointment, it is deemed reasonable to comply with Professor Bache's request to make a careful examination of his labors, and inquire if the high expectations which had been formed have been realized; if there has been so rich a harvest of valuable results as might have been anticipated; if the best methods of observation have been uniformly adopted; and if the survey has been conducted throughout with proper economy and despatch. Your committee have made this examination to the best of their ability, and have thought it advisable to present their conclusions in as simple and condensed a form as possible. The tone of the report is necessarily laudatory, for the committee are persuaded that the minutest and most conscientious scrutiny will find everything to approve and nothing to condemn.

1. The methods and instruments of observation appear to be, in all cases, the most convenient and accurate which are known; while, in some striking instances, they are such as were not known or tried in geodetical operations before they were introduced upon this survey. It is, moreover, grateful to record that some of the most important of these improvements are of American origin. The committee beg leave to refer to some examples.

The apparatus for measuring the base lines is so portable that six and three-fourths miles are measured in ten working days, and so accurate that the whole amount of possible error in this distance would not exceed one-half an inch. This beautiful apparatus, which is incomparably superior to any which has ever before been adopted, is in principle and combination the invention of the Superintendent himself. It is a compensating system, and is in this respect closely allied to the elegant arrangement invented and used by Mr. Borden in the survey of the State of Massachusetts, but the method of compensation is novel and original in an essential and characteristic feature.

The method which has been finally adopted for the measurement, astronomically, of differences of latitude, is that which was invented by Captain Talcott, late of the Corps of Engineers of our Army, and which had not before been used for geodetical purposes. A full description of this method has been recently published in an unusually handsome form by the Topographical Bureau of the War Department, in a memoir written by Captain T. J. Lee, which con-

tains some examples from the Coast Survey observations. From this publication, it appears that the latitude is given, by a single night of observation, to the fraction of a second of arc, and that in four or five nights it can be determined with the minutest accuracy of which astronomical measurement is susceptible. The instrument employed is of simple construction, and of little cost, while its accuracy must render it available for some most delicate geodetic and geological researches. It is not impossible that, in the hands of a skilful geologist, it may aid in determining the various densities of the crust of our globe, and thereby serve as a divining rod for detecting its internal wealth; and it may thus give birth to a new species of practical astrology.

The use of Morse's magnetic telegraph for the determination of astronomical differences of longitude was too obvious to escape early notice, but it was reserved for the Coast Survey to ascertain its practicability as an exact method. This has been done by a series of refined and careful observations made under the direction of Mr. Sears C. Walker, from which it appears that differences of longitude thus determined can be employed in the measurement of the earth in a direction perpendicular to the meridian. This conclusion is of great importance in reference to the survey of a coast, which deviates from the arc of a meridian so much as that of the United States. The introduction of clockwork into the magnetic operations will undoubtedly contribute to their accuracy, although it remains to be seen which of the different plans which have been devised will be the preferable one.

Professor Bache's method of employing the great theodolite in the primary triangulation must command the admiration of experienced observers for its conscientious accuracy, and its skilful and faithful determination of every correction and every source of error. His measured angles have rewarded his patience and perseverance, by submitting to the usual tests with a uniform exactness which has never been surpassed, and which proves that one-fifth of a second of arc is the greatest error to which any one of his angles is liable. This extraordinary accuracy is not attained at any sacrifice of time; but, on the contrary, the present Superintendent has completed the observations at each station in much less time than was required by his predecessor, because he has rejected an unnecessary and injudicious rule in regard to the selection of days of observation.

All the other portions of the field work, whether of the reconnoissance, of the primary, secondary, or tertiary triangulation, or of the topography or hydrography, and also the office work, are distinguished for the same scrupulous regard to accuracy and despatch. The observations, indeed, which are made in the field by one set of officers, are reduced and plotted by others in the office, so that there can be no danger of any deception, and every thing must be as good as it appears. The observations of the Superintendent himself are not excepted from this ordeal.

The committee cannot pass from this head of their inquiry without expressing their commendation of the beautiful execution of the charts, and of the wise liberality with which they are furnished to navigators at a trifling cost.

2. The survey has already embraced a very extensive portion of the coast, and numerous discoveries have been made of the highest importance to navigation. "The field or office work of the survey has been carried into every State on the Atlantic and Gulf of Mexico, except one." Every year results have been obtained of a mercantile value incomparably superior to their cost, and which would be sufficient to pay, again and again, for the whole year's work. To say nothing of the many important discoveries of useful channels, or of hidden and unknown dangers, in Long Island sound, in Buzzard's, Massachusetts, Chesapeake, and Mobile bays, who can estimate the value of Ged-

ney's channel* to New York harbor? Of the determination of the changes in the main ship channel, which have been so gratefully acknowledged by the Chamber of Commerce of New York; or of Blake's new channel in Delaware bay; or of Davis's discoveries of the shoals in the vicinity of Nantucket, for which the insurance offices of Boston and New York have acknowledged their obligation; is not each of them separately worth the whole amount which has been expended upon the work? But leaving these remarkable discoveries to the merchants and sailors, who are most competent to appreciate them, your committee would draw the attention of the Academy to some other results, of a less practical, but no less scientific interest.

3. From the variety of his scientific attainments, the attention of the Superintendent has been readily drawn to all classes of observation which would conduce to the progress of science, and which could be made by himself or any of his parties without obstructing their other duties. Thus the abstruse problem of the figure of the earth will undoubtedly receive its due consideration, when the primary triangulation is completed; and also the local variations of figure in connection with those differences of internal density, the detection of which is already to be enumerated as one of the scientific discoveries which have been made upon the survey.

The intricate problem of the tides, also, which is still so defective, notwithstanding the labors of Laplace, Airy, Lubbock, and Whewell, will undoubtedly receive new development from the observations of the survey, and the laws of the tides upon the American coast will be ascertained.

The exploration of the Gulf Stream, which was commenced by Lieutenant Davis, and so indefatigably pursued, even to the sacrifice of his life, by the lamented George M. Bache, has led to results which are of profound scientific importance; and the deep sea soundings, which have been examined by Prof. Bailey, are also replete with interest to the naturalist.

4. Your committee have few data for arriving at any definite conclusion with regard to the extent of the economy with which the survey has been conducted. They are not, however, aware of any objection to the comparisoc which has been instituted by the Superintendent with the surveys of the Land Office, and which is very favorable to the Coast Survey. There is certainly no appearance of waste or extravagance in any respect; there are no excessive salaries, no idle attachés, nor any apparent disposition to pay too much for services rendered. There seems, on the contrary, to be an anxious desire to husband the appropriations of Congress, and to derive from them the largest possible return of valuable results. It is especially deserving of notice, that the Superintendent has manifested the wisest and most unselfish economy in asking for large appropriations, in order that he may press forward the work as rapidly as possible to its final completion.

In conclusion, it is the deliberate opinion of the committee that the present Superintendent of the United States Coast Survey has, by his able and judicious, his energetic and economical, administration of this great national work, raised it to the highest state of successful activity and deserved popularity, and that he has thereby fulfilled the high expectations which were raised at his appointment. All of which is respectfully submitted by

BENJAMIN PIERCE, J. I. BOWDITCH,
DANIEL TREADWELL, JOSEPH LOVERING.

American Academy of Arts and Sciences,
Boston, 6th February, 1849.

The committee was appointed at the quarterly meeting of Wednesday, January 31, 1848.

*Gedney's and Blake's channels were discovered during the administration of Mr. Hassler.

Memorial of the MARINE SOCIETY of Boston, in relation to the Coast Survey.

To the honorable the Senate and the House of Representatives of the United States in Congress assembled:

The undersigned respectfully represent, that they were appointed, on the 6th instant, by the "Boston Marine Society," to act upon the following vote, passed on the day named:

"*Resolved*, That this Society has heard with regret that an attempt has been made to impair the present useful and efficient organization of the Coast Survey, and that the committee charged with the matter relating to buoys and beacon on Nantucket Shoals be authorized to address Congress, if deemed expedient, in the name of the Society, in order to prevent any action which may tend to injure the efficiency of the Coast Survey."

Wherefore, the undersigned pray that no change be made to curtail in any way the plan as laid down and submitted to Congress by the Superintendent of the Coast Survey in 1846; but that the appropriation be made from year to year, so that the progress of the survey may be simultaneous in every section of our coasts. (Signed) R. SOULE,

President Boston Marine Society.

R. B. FORBES,
W. A. WELLMAN,
THOS. B. CURTIS,
Committee.

BOSTON, *Feb.* 15, 1849.

Memorial of the INSURANCE COMPANIES *of* BOSTON *in relation to the Coast Survey.*

To the honorable Senate of the United States:

Having discovered that notice has been given in the Senate of the United States of an intention to ask for the renewal of the law of 1818, concerning the Coast Survey of the United States, by which the employment of citizens upon the work was prohibited, and believing that the real effect of that law would be now, as it was in 1818, to destroy the organization and arrest the progress of this important work, the undersigned, representing the interest of the insurance offices in Boston, beg leave to present to your honorable body the following memorial:

The undersigned, being constantly concerned in the security of the navigation of our own shores, have watched with interest the condition and progress of the Coast Survey, and being satisfied that every year it is rendering very valuable service to the commerce of the country by its accurate charts, and by its important discoveries, would earnestly pray against any movement by your honorable body that would cause an interruption to its useful labors.

Your memorialists are satisfied that the present organization of the Coast Survey, which embraces, in one combination, the most distinguished private science and skill of the country, and the professional science, ability, and zeal of the military and naval services, is better suited than any other to insure the prosperity of this great national work, to provide the best judgment in directing its plans of operation, and the greatest skill and fidelity in their extension.

Your memorialists have witnessed, with great pleasure, the liberal support that has been given to this work during the last four years, and believe that there is no public undertaking more worthy of the patronage of Congress than this, which has for its objects to give facilities to trade, to enlarge the bounds of useful knowledge, and to protect human life.

Your memorialists trust that this liberal support will not only be continued, but also extended, as far as may be consistent with economy and required by

useful progress, and do earnestly entreat your honorable body to take no action that will impair the usefulness of this important branch of the public service.

J. INGERSOLL BOWDITCH, *Pres. American In. Soc.*
LEMUEL POPE, *Pres. Boston In. Co.*
C. CURTIS, *Pres. Neptune In. Co.*
JOHN G. NAZRO, *Pres. Tremont In. Co.*
SAMUEL QUINCY, *Pres. Hope In. Co.*
SAMUEL W. SWETT, *Pres. National In. Co.*
NATH. MERIAM, *Pres. Mercantile Marine In. Co.*
ROBERT B. WILLIAMS, *Pres. United States In. Co.*
FRANCIS WELCH, *Pres. of the Franklin In. Co.*
JOSEPH BALCH, *Pres. of Merchants' In. Co.*
THOMAS LAMB, *Pres. of Washington In. Co.*
P. W. HAYWARD, *Pres. of Suffolk In. Co.*
FRANCIS BACON, *Pres. of Boylston In. Co.*
JOS. H. ADAMS, *Pres. of N. E. Mutual Marine In. Co.*
JOHN CLARK, *Pres. Equitable Safety In. Co.*
JNO. L. DIMMOCK, *Pres. Warren In. Co.*

BOSTON, *Jan.* 19, 1849.

REPORT *of a Committee of the* CHAMBER OF COMMERCE *of* NEW YORK *on the United States Coast Survey.*

The act for the survey of the coast passed in 1807, and several plans were submitted for carrying out the law. The one proposed by F. R. Hassler, esq., who had been engaged in a triangulation of Switzerland, viz., that by means of a series of triangles extending the whole length of our country, was approved of.

The difficulty of obtaining the necessary instruments and the standards for the measures of length at that time, Mr. Hassler being obliged to visit Europe for the purpose, and the declaration of war during the period of his absence, prevented the actual field operations until 1815, and immediately after, in 1818, a stop was put to the work by the passage of a law, the purport of which was to employ none but officers of the army or navy on the work. This hasty legislation placed Mr. Hassler out of the work, and left it without a head; and although the instruments were at hand, and moneys expended by the Government in surveying our coast in several parts, yet nothing was done, during a period of fourteen years, that could be considered of *any use whatever* in continuing the work itself, and very little knowledge was given to the world as to the hydrography of our own shores by any of them. In fact, at the period of 1832, when the act of 1818 was repealed, and Mr. Hassler again placed at the head of the work, there was not on our whole coast six light-houses whose position was known nearer than one minute of latitude, and the surveys in possession of the Government gave little or no information as to the position either in latitude or longitude. The hydrographical offices of other nations could not obtain the position of any of them, and an official list, published even after this period, was worse than useless.

At the recommencement, the corps was organized under the Treasury Department; and at the period of Mr. Hassler's death, 1842, the work had been extended from the base on the south side of Long Island to the western part of Massachusetts, and into the eastern part of Maryland, but had not been completed; since which period, the work has been extended into and commenced in every State on our sea-board with a degree of energy peculiar to our country; so much so, that the progress now of the Coast Survey yearly

surpasses that of any other country at any time, and stands in bold relief with any of our great undertakings.

The committee trust that no experiments in the way of reduced appropriation or diminution will be made by Congress to put in jeopardy a work in which the whole commercial world are interested; and that, while Great Britain is surveying the West Indies and her possessions to the north, and throwing the knowledge broadcast to the world, we will not be behind hand.

Independent of the annual appropriation for the ordnance survey of Great Britain, which includes the triangulation and topography, the expenditures for hydrographical purposes (exclusive of Arctic and Antarctic expenditures) were, during the period of the years (from 1837 to 1847,) £1,036,334, *upwards of five millions of dollars.* A large part of this amount was expended at home, while, as Rear Admiral F. Beaufort, hydrographer, states in his report, "on an average of the last few years, the admiralty have employed on foreign surveys 11 vessels and about 950 men; and that, however incumbent on this country to take the lead in such efforts, still this amount of force, if properly distributed and constantly employed, may be fairly considered as our full share of that great duty which all maritime nations owe to the interests of navigation."

While the first commercial nation is thus anxious to do her share in extending hydrographical knowledge over the globe, we would ask of Congress such liberal appropriations as will enable the department having charge of the work to finish the survey of our own coast in a manner creditable to the present advanced state of science, and to extend it to our Pacific shores, so that "our full share of the great duty" shall not be wanting.

(Signed) GEO. W. BLUNT,
M. H. GRINNELL.

RESOLUTIONS *of the* CHAMBER OF COMMERCE *of* NEW YORK *in relation to the Coast Survey.*

CHAMBER OF COMMERCE, *New York, February 6th,* 1849.

At a regular meeting of this Chamber, held to-day, the following resolutions were presented and unanimously adopted, and ordered to be transmitted to the Senate and House of Representatives:

Resolved, That, in the judgment of this Chamber, the continued prosecution of the Coast Survey is due not only to the interests of our merchants, but as an act of simple though tardy justice to the sea-faring classes of the United States, whose energy, skill, and fearlessness, have made our flag known in every part of the navigable globe.

Resolved, That it might be deemed a matter of just reproach, that the second commercial nation of the world should consent to owe a large debt to other nations for hydrographical knowledge, without making adequate efforts to repay the debt in part, as the United States are now doing through the U. S. Coast Survey.

Resolved, That we ask of our Senators and Representatives in Congress by their votes to keep up the appropriation necessary for this great and useful national work, conducted as it is with science, energy, and economy.

Extract from the minutes.

Attest: (Signed) JAMES G. KING, *President.*
(Signed) P. M. WETMORE, *Secretary.*

REPORT *of a Committee of the* AMERICAN PHILOSOPHICAL SOCIETY *of* PHILADELPHIA *on the Coast Survey.*

The committee to which was referred a letter from Prof. Bache, Superintendent of the U. S. Coast Survey, asking the consideration by the society of

the scientific character and results, of the practical results, and the progress of the survey, and inviting any suggestions tending to improvement in the different departments of the work, respectfully submit the following report:

In coming to these conclusions, they have necessarily assumed the correctness of the statements as to the progress and results of the survey made by the Superintendent in his annual reports to Congress. The committee are not aware that any doubt has ever been expressed as to their correctness; and had they been questioned, it would have been impossible for the committee to verify them. The question for their examination appeared to them therefore to be, not whether these results have been attained, but whether, in a practical point of view, they justify the yearly expenditure authorized by Congress, and whether their scientific character is such as the means at the disposal of the Government justify us in expecting, and such as is likely to meet the approbation of scientific men in our own and in other countries.

It cannot be a matter of surprise that the American Philosophical Society should undertake these inquiries, since, originally consulted by the Government as to the propriety of instituting such a survey and the manner in which it should be conducted, they have ever since, on all proper occasions, testified their interest in its efficient prosecution.

The object of such surveys as that which is now in progress along our sea coast, is to determine with accuracy the position of every conspicuous fixed point within the limits of the survey. By which determination, and by the aid of the conventional marks for different objects used in topographical drawing, an accurate representation may be made of the country surveyed, so that the relative position of any objects, their distance apart, the character of the country between them, and their elevation above the level of the sea, as well as the position and figure of shoals, the depth of water upon them, and the nature of the bottom, the direction and force of the currents, whether oceanic or tidal, the time of high and low tide, with its rise and fall in our principal ports, may be easily and precisely known.

There is scarcely a branch of physical science (chemistry alone excepted) to which such a survey is not in the highest degree useful; but its practical results are those of the most prominent importance. It permits the sailor, who comes for the first time upon our coast, to recognise with accuracy his position, and direct with precision his vessel to its port. It warns him of the dangerous shoals which lie in his path, and indicates to him the existence and strength of currents which may retard or assist his progress. And if he be surprised by a tempest which jeopards his safety, it guides him to a harbor of refuge where he may await more favorable weather. It enables the Government to select with certainty the best situations both for works intended for the defence of the coast against hostile invasions, and for light-houses and buoys which are to serve as guides to our commerce; and, when extended inland, it indicates the best routes for internal communication, the obstacles to be overcome in its establishment, and the resources which the country presents for its maintenance. It may be truly said that a government owes such surveys as this to its citizens, and since they inure in the highest degree to the benefit of all, and since the means of accomplishing them are possessed by the Government only, it is one of the most important duties to have such surveys executed in the most complete manner possible.

In our system of finance the greater part of the revenue of the Government is derived from the duties paid by our commerce, and the demand that a small portion of the immense wealth, which is thus annually poured into the Treasury, should, for a few years, be expended in protecting the lives and property of those thus contributing, is so plainly just as to need no argument in its support.

The actual receipts from customs in the Treasury, for the fiscal year ending June 30th, 1848, was $31,757,070 95, and the estimated receipts for the next year $32,000,000. The appropriation asked by the Superintendent for the Coast Survey, for the same year, is $186,000, 1-172 of the receipts, or 58 cents on the hundred dollars. Nor is the policy, in a financial point of view, less evident. The committee has found it impossible to get any definite information as to the average amount of dutiable goods yearly wrecked upon our coast; but the actual duties paid in 1848, by five packet ships, in the port of Philadelphia, was $243,942 15, or an average of $48,788 each. A loss of duties equivalent to those paid by four such ships on our coast would amount to more than the estimate for the expenses of the survey of 1849; the value of one such ship and cargo would probably have defrayed all the expenses of the work for the two years 1847 and 1848. The loss of time by ships compelled, for want of accurate charts, to await far from the shore the arrival of pilots, in place of running close into land where they may be at all times found, and the higher rates of insurance against dangers of which just enough is known to render them formidable, but not enough to permit them to be avoided, must also be added in the calculations of the pecuniary advantage of such a survey; while the continually recurring loss of life by shipwreck, and the immense amount of human suffering caused by the detention of crowded passenger ships off our coast, especially in the winter season, forms an item of which no estimate can be made in such a calculation.

If, then, our coast be peculiarly liable to such dangers as these, if it be dangerous in its character and comparatively unknown, the duty of the Government to make and publish such charts as shall give every possible facility and safety to our commerce cannot be denied. That this is the character of our coast is almost too well known to need assertion; but if proof be required, we have but to turn to the reports of the survey, for the last few years, to satisfy the most incredulous. Within that time channels of vast importance to commerce, before altogether unknown or unused, have been discovered in the harbor of New York and in the Delaware bay; and six unknown and dangerous shoals have been discovered, within the last year, lying in the direct track of the commerce between New York and Europe, as well as in the coast trade between the former place and New England. Of the Delaware bay, until the recent publication of the maps of the Coast Survey, there was no chart upon which reliance could be placed. Some of the most dangerous shoals were placed from three to seven miles in error. The light-house at Bombay Hook, a neighborhood at one time noted for the number of vessels grounded there, was five miles out of place; and the mouth of the bay, between Cape May and Henlopen, was represented from 16 to 18 miles, when the survey shows it to be but eleven and a half. Yet, over this unknown and dangerous ground passed yearly, according to a report made to the Government, about the year 1837, by Major Bache, of the Topographical Engineers, an insurable interest, created by the coal trade alone, amounting to $22,000 per annum, estimating the vessels in ballast coming after it, and the value of the vessel and cargo carrying it to the various ports at which it is wanted. Many of these vessels, however, instead of ballast, bring to Philadelphia cargoes of plaster, fish, lumber, salt, &c., the value of which is of course not included in the above estimates; and it is well known that few of these vessels employ a pilot. To such an extent has this coast trade increased, that, while in 1836 there cleared from Philadelphia 3,225 vessels, carrying 344,812 tons, the number of clearances in 1846 was 8,953, carrying 1,065,228 tons. Along the southern part of our country the coast is of course still less accurately known, since it does not lie in the track of the extended trade passing over the

points which we have alluded to above. These few facts will be sufficient to show the pressing necessity which exists that a coast so little known and of so dangerous a character, from its exposure and the number of its shoals, should be, as soon as possible, accurately and thoroughly explored.

In order to accomplish a work of such extent with the requisite precision, it is necessary to make available to its purposes all the refinements which mathematics and physical science have added to the art of measurement. The original base lines, which form the starting points of the survey, require to be measured by apparatus of the most delicate nature, since any error committed in this early part of the work will necessarily be multiplied throughout the series of triangulations which rest upon them. The bases of verification require to be measured with the same degree of accuracy, as otherwise they could not serve as a check upon the calculated results. Nor is less precision necessary in the measurement of the angles of the primary and secondary triangulations, which serve as checks upon each other, since the position of any point in the former is determined by each of those series. And again, at every important point the astronomical observations for latitude and longitude again contest the results of the geodetic operations. In this way, although absolute accuracy can never be expected from human work, and especially from that which requires so many observations and calculations for its elaboration, yet the possible error is reduced to so small a quantity that it may be for all purposes of commerce and internal improvement neglected. But to obtain these results the whole resources of science are requisite; and it is necessary that he to whom such a survey is entrusted should have a thorough familiarity with what has heretofore been done in this regard by other nations, and should possess besides that degree of talent and profound science which will enable him to judge of the results of the eminent men who have preceded him, to select what is worthy of imitation in their processes, and improve on that which is defective.

When, however, a survey of this kind is conducted with the requisite degree of precision, its results become incalculably useful, not only in a pecuniary point of view to the government and citizens, but to the advancement of science, and through it of civilization and the general welfare of mankind; and there are in many branches of science problems, not yet definitively solved, to the correct elucidation of which the observations of the Coast Survey will become available. Hence the cause of science, not less than that of self-interest and humanity, is involved in the proper conduct of such a survey; and by its promotion, while we improve our commerce and relieve our seamen from a portion of the dangers to which they are exposed, we shall raise our national character and justify our position among the great nations of the earth.

If now we attempt to compare our Coast Survey with similar works executed abroad, we shall find just cause of pride in the manner in which it has been conducted.

The regulation introduced by the present Superintendent, by which the field work at first computed by the party making it is afterwards subjected to a second calculation by others not connected with them, is such as to prevent the introduction of accidental errors, and to remove altogether the possibility of tampering with the observations. It therefore allows implicit confidence to be placed in the work.

The measurement of the more recently selected bases has been made by a new apparatus, contrived by the Superintendent for the purpose, (the description of which will be found in his report for 1847, and in the Proceedings of this Society, vol. IV, p. 368,) in which the arrangements for the support of the bars, compensation for temperature, accuracy of contact, and delicacy of

adjustment, are such as in the opinion of the committee to leave nothing to be desired; while the apparatus is so simple, and so easily manipulated, as to allow of a rapidity of work which, it is believed, has never before been obtained. The measurements by this instrument are of course verified by the most severe and improved methods, and the agreements of the various measurements, some of which were made under circumstances peculiarly unfavorable, shows a degree of accuracy which has certainly never been surpassed.

The application of the electro-magnetic telegraph to the determination of difference of longitude, and the invention of a clock by which the time is accurately registered without the intervention of any assistant, at stations at any distance apart, allows the correct difference of time between two places to be determined within a very small fraction of a second, and will give the means of getting the differences of longitude between the principal cities with a degree of accuracy which had only been obtained at the principal observatories of Europe after many years of continued observations and comparison.

Improvements upon the astronomical apparatus used, and careful experimen tal observations upon the relative efficiency of different forms of instruments and different modes of observing, have led to great accuracy in the observations for the determination of latitudes, so that the places of the smaller stars, as given in the catalogues, cannot now be sufficiently precise for the work, and the positions of the stars used have to be determined by direct observations. The arrangements for having the maps, after reduction, engraved in the office of the survey, under the immediate inspection of an assistant, and then, after two separate verifications, submitted to the Superintendent before publication, is calculated to maintain the accuracy of the field work upon the maps issued, as far as that is possible.

The charts issued from the office bear the marks of the great care which has been bestowed upon them, and as specimens of topographic art are not exceeded by any which the committee have seen.

The same attention to insure accuracy is especially visible through the whole plan of organization and the details of the work. The committee cannot but repeat that, in their opinion, our Coast Survey will in this respect bear comparison with the best geodetic measurements of Europe.

As to the efficiency and rapidity of progress of the work, it is not possible to make a minute comparison, since in no other work of the kind is there any annual report from which its progress may be judged of, nor indeed was there in the Coast Survey until this feature was introduced by the present Superintendent. Nor can any statement of the number of square miles accomplished in any year give a fair standard of comparison between two surveys in different countries. The nature of the ground, the climate, and many other causes, operate too strongly to retard or facilitate works of this kind; so that any parallel founded upon them cannot but be fallacious. The ordnance survey of Great Britain, commenced in 1791, has been continued from that time, and is, we believe, not yet finished. Our own survey was actually commenced by the late Mr. Hassler in 1817; discontinued from that time until 1832, when it was recommenced; and has been prosecuted continuously to the present time. The triangulations now extend in a connected series from Maine to Virginia; and have been commenced in North and South Carolina, Alabama, Mississippi, Louisiana, and Texas. Since the work has been in charge of the present Superintendent, (that is, since 1844,) an area of 19,309 square miles has been triangulated; the topographical surveys with the plane table have covered 2,755 square miles, and embraced an extent of shore line of 4,055 miles. The hydrography has covered an area of 15,086 square miles; of which 11,000 were principally off-shore or deep-sea work. 21 sheets of maps and charts have been published.

The plan adopted by the present Superintendent, by which the survey has been simultaneously started at different points of the coast, presents striking advantages in more than one point of view. It extends the benefits of the survey more speedily to all parts of the country, reduces the time necessary for the completion of the work, and, as the Superintendent has shown in his reports, diminishes the total expenditure necessary for it. The minute division of labor, and the specific instructions from the Superintendent to the various parties as to their duties, are well calculated to promote activity and increase the efficiency of the work—an end which will also be greatly assisted by the honorable and friendly rivalry which evidently exists between the civilians and the officers of the army and navy engaged on the work. In fact, so much and such excellent work could not have been accomplished within so short a time, except by extraordinary energy on the part of the Superintendent, seconded by the cordial and zealous co-operation of all those under his charge; and the annual reports of the Survey indicate an amount of scientific talent and knowledge, as well as energy and enterprise among the numerous assistants, which is highly honorable to our country.

The expense of conducting such a survey as this must necessarily be great, though by no means so in reference to the advantages obtained from it. From the year 1844 to 1848, (the period during which it has been in charge of the present Superintendent,) the appropriations to the survey have amounted in the aggregate to $622,000; and if we add to this the estimate for 1849, we shall have a gross amount of $818,000 as the cost of the survey for six years. It is true that the expenditure has been every year increasing, but it is equally so that such increase has expedited the operations of the survey in a still higher ratio, and has thus actually diminished its final cost. Thus, while in 1844 the cost of fifteen parties (with less field work in all the departments) was $100,000, in 1848 thirty effective parties have been kept in action for $130,000; that is, an additional expense of 30 per cent. has doubled the efficiency of the survey. In fact, so economical has been its management that, notwithstanding the far more elaborate work and the much greater precision, the expense of the survey is shown scarcely to exceed that of the survey of the public lands executed for the Government. For the reasons before stated, and for others which will easily suggest themselves, it can scarcely be deemed fair to attempt a comparison of the topographical map of Great Britain, yet such a comparison may perhaps serve to defend the U. States well from a charge of extravagance. The cost of the ordnance survey of Great Britain, from 1812 to 1848, is stated by a writer in the London, Edinburgh, and Dublin Philosophical Magazine, (April, 1848,) at £1,500,000, or about $7,500,000. A survey of the city of Dublin for municipal purposes was stated in Parliament to have cost £200,000, or $1,000,000; and it was at the same time stated that the surveys of the city of London, under the Parochial Assessment act, had already cost £300,000, or $1,500,000, yet a new survey of this latter city is now in progress. With these data before us, and an attentive study of the estimates of the Superintendent, it is scarcely possible to doubt that the Coast Survey has been carried on with all possible economy consistent with its efficient prosecution.

If it be asked what results of a scientific or practical character has accrued, or are likely to accrue, from this vast work, a hasty glance at its progress will furnish an adequate answer.

Accurate charts have already been published of the Bay of New York, and the Delaware Bay, and approaches to the city of Philadelphia, and of six other harbors; and of the former one map upon a large scale, occupying six sheets, and another in one sheet, has been issued. Of some of these harbors no maps

of a trustworthy character were before in existence; and in all of them important corrections have been made, new channels indicated, unknown shoals pointed out, and the increase or decrease of the old ones marked, the soundings and nature of the bottom carefully noted, and every information given which can be of service to vessels desirous of entering.

The plan adopted by the present Superintendent for publishing the results of the survey as fast as the maps can be prepared, cannot be too highly approved. There can be no reason why, after the work on a certain part of the coast has been finished and verified, those who are benefited by its results should be kept waiting until the whole of so vast a work as this can be completed. Why the main trade of our principal cities with Europe should continue subject to the annual risk arising from insufficient maps until the whole of the shores of the Gulf of Mexico have been surveyed.

The value of the publication of these maps has been materially enhanced, too, by the liberal policy of the Government in allowing them to be sold at such a low price as to put them within the reach of all who may require them. By this judicious course their introduction, in place of the insufficient and often treacherous guides which they are to replace, will be much more rapid, and they themselves being more widely disseminated, will be far more useful.

Another practical benefit of incalculable importance, which we already owe to the efficient prosecution of the Coast Survey, is the discovery of dangerous and sunken rocks and shoals before unknown, yet lying directly in the path of our principal trade. In addition to the discovery of a new channel into New York Bay, having two feet more water than the old channel; of two new and important channels into Delaware Bay, one of which is open when the old channels are choked up with ice, and is thus invaluable in the winter season to our coasting trade; and of another on the coast of the State of Mississippi, the Coast Survey has already detected and published nine dangerous shoals in the vicinity of Nantucket, and numerous rocks in Long Island sound and its vicinity. If these were the only practical benefits to be derived from it, they would more than repay all its expenditures. Obstructions of a similar character have been discovered in the Delaware and Chesapeake bays, and doubtless many more will reward its labors upon the coast further southward.

The information derived from the Coast Survey has been made useful in the determination of the proper sites for light-houses along our coast, and in assisting the local surveys which the authorities of the various seaboard towns desire to have made; and when, in the progress of civilization, the citizens of our different States shall feel the importance of following the excellent example set them by Massachusetts, and of substituting true topographical maps of their territories for the fancy sketches which now bear that name, the results of the Coast Survey will be found of great utility to them in establishing their bases and verifying their work.

But, after all, the great practical utility of the work will be found in the publication of cheap and trustworthy maps, which, while they furnish valuable information to all, will be instrumental in diminishing that fearful loss of lives and property which annually takes place along our extensive and exposed coast.

When we turn to inquire what benefits to science have arisen, or are likely to arise, from the Coast Survey under its present organization, their number and importance almost preclude an elaborate reply.

The first and most prominent point of scientific interest upon which its results will be brought to bear, will of course be the determination of the length of a degree of latitude on different parallels, and from this of the figure of the earth. A problem considered of such importance that surveys, more costly

than that of our coast is likely to be, have more than once been undertaken by European nations for the sole purpose of obtaining its solution. And France, with that honorable zeal which has placed her first in all matters of physical science, has sent parties of her ablest men to the most remote regions of the earth to execute these measurements. As our survey when completed will extend over about 20° of latitude, the opportunity of controlling the results of former determinations will be most excellent, and most advantageous to science.

The vast number of astronomical observations of different kinds, for the determination of latitude and longitude, extending from Galveston to the northernmost point of the coast of Maine, the experimental observations for the determination of the relative value of different instruments and different methods of observing for the nice determination of celestial phenomena, and the elaborate discussions of the formulæ for reduction and correction of errors, by the able astronomers whom the Superintendent has engaged in those labors, must be of inappreciable importance to practical astronomy, for which we as a nation are already obtaining a high character.

The application of the electric telegraph to the determination of longitude, and the invention of the self-registering clock, are improvements the vast importance of which cannot be overlooked.

The development of the laws which govern the distribution of sediments at the bottom of the sea and along the coast, the microscopic examination of the various infusoriæ which live in them, and the establishment of safe data from which any future elevation or depression of the land, however gradual in its progress, may be detected, will be found as important to the geologist as the results which we have just alluded to are to the astronomer; while the extensive and delicate magnetic observations, the study of the tides and oceanic currents, cannot fail to furnish a vast body of the most carefully determined facts, capable of giving to the physical science of our country an impetus which it has never yet received; while the training of our officers of the army and navy to scientific observations, and, what is far more important, the education of a body of young men in the strictest school of modern experimental science, may be ranked among the most important advantages either in a practical or scientific point of view.

It is not to be expected that, confined to the examination of the results of the work as published, and without access to the official records, the committee could make any suggestions likely to lead to any practical improvement in the conduct of the work; it is evident from the results that the superintendence of Prof. Bache is very active in this respect, and the members of the society have been long enough associated with him to know that nothing in the way of improvement is likely to escape his notice or to meet his neglect. Your committee however would respectfully call his attention to the fact, that, if consistent with his duties and means, the early publication of the original observations, astronomical, magnetic, hydrographical, and others, would be of vast service to the practical science of the country, and is anxiously looked for by its cultivators.

In performance of their duty, the committee have been compelled to confine themselves to an indication merely of the most important conclusions to which their examinations have led them. To enlarge upon the points suggested can scarcely be necessary in a report to a scientific society, and would have occupied more time than their other pursuits would allow, or the society would have at its disposal. But enough, they think, has been said to warrant them in relying upon the approbation of the society in their conclusions.

That the survey of the coast is a work, which from its importance to our citizens, recommends itself in the strongest manner to the protection of the Government.

That the benefits of a scientific and practical character, which have yalread been derived, and are constantly resulting from it, are such as to repay abundantly the labor and expense which has been and may be hereafter devoted to it.

That it has heretofore been conducted accurately, efficiently, and economically, and that there is every reason to believe that it will best thrive by being left with its present organization.

And that, as well from the magnitude of the undertaking as from the skil[illegible]e and energy with which it has been conducted, it will prove honorable to thos who first conceived it, and to those who have been engaged in its prosecution.

The American Philosophical Society therefore recommends to the Superintendent of the U. S. Coast Survey the publication, as speedily as shall be consistent with the interests of the survey, of the observations upon which the published results are founded, and of all others made during its progress, as well as the formulæ for computation and reduction, and the discussion of the correction of errors from the observed results.

And the committee respectfully ask to be discharged.

R. M. PATTERSON,
JOHN F. FRAZER,
E. OTIS KENDALL,
J. K. KANE.

Survey of the Coast of the United States.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania for the Promotion of the Mechanic Arts, to whom was referred for examination and report the subject of "The Progress of the Survey of the Coast of the United States," report—

That the Survey of the Coast of the United States is one of those great national duties which our Government owes to its own citizens and to the world at large. In the present advanced condition of civilization and enlarged commerce, it would be a matter of great surprise should we find so important a duty overlooked entirely, or prosecuted with such unwillingness as to cause it to fail in its practical benefits to society.

The duty of a Government constituted like our own, whose care of the commerce of the country is exclusive of all interference from the States, and extends over a greater sea, bay, and river border than that of any other in the world, is, perhaps, more imperative upon this point, than that of the governments of countries of more limited space in these particulars.

The importance of such knowledge as an accurate measurement and delineation of the coast would give was early felt by the people and authorities of the Union, and the plan for such a survey, to be prosecuted with the best lights that physical science then afforded, was adopted by President Jefferson in the year 1807, and the appointment of the late Mr. Hassler to the office of Superintendent was made by him.

Owing to the difficulties in which the country became involved about that time, from the disturbed condition of Europe, and to the subsequent war which took place between the United States and Great Britain, Mr. Hassler was unable to procure the necessary instruments for the work, or to undertake its prosecution until the year 1817. Shortly afterwards the law under which he had been appointed was modified, so as to exclude civilians from official positions on the survey; and it was not until the year 1832 that Mr. Hassler, under a re-appointment, commenced his labors in actual service.

From that time until his death, which occurred in the year 1843, he was engaged in prosecuting the work in the northern part of the United States, and

his measurements embraced portions of the States of Delaware, Pennsylvania, New Jersey, New York, Connecticut, Rhode Island, and Massachusetts.

Although the actual labors in the field were great, and much valuable information was collected, it was not deemed expedient by the late Superintendent to publish the preliminary results, to any great extent, in the form of maps and charts.

In 1844, Prof. Alexander Dallas Bache was appointed to the office of Superintendent, made vacant by the decease of Mr. Hassler, and he immediately addressed himself, first, to the proper measures for closing up and verifying the work of his predecessor; and, second, to the publication of the ascertained results in a practical form.

The credit, therefore, due to his predecessor having been fairly and fully awarded, Prof. Bache could safely complete the triangulations of those portions of the coast, and commence the publication of the maps and preliminary sketches—thus rendering the work immediately available. While this has been the case with the work as it stood in 1844, new base lines have been measured to the north and south of Mr. Hassler's work, and the survey is now progressing in eighteen States on the eastern coast, and a party organized for the preliminary examination of the western coast. When the committee states that these labors cover the whole of the coast line of the Atlantic and Gulf of Mexico, with their tributaries, and are intended to extend over the whole of our coast line on the Pacific ocean, with its immense but little known tributaries, some idea may be formed of the scope and value of such a survey. It first addresses us in its practical character as a commercial nation—the second in the world, whose foreign commerce in imports and exports amounts to about $300,000,000 annually, and whose domestic or coasting trade is probably equal to as many millions yearly. In the year terminating June 30, 1847, 14,229 vessels, of an aggregate tonnage of 3,321,705 tons, arrived in the ports of the United States, and 14,370 vessels, of an aggregate tonnage of 3,378,993 tons, cleared from the same. The tonnage employed in the coasting trade was 2,839,045 tons, and some of these coasters make ten or twelve trips per annum. The number of emigrant passengers that arrived from foreign countries was nearly 240,000, and the officers and mariners engaged in our maritime commerce amount probably to 100,000 souls.

We can scarcely conceive of the perils to which such a mass of property and life is subject in approaching our extensive and dangerous coast; and, although light-houses and buoys have been erected to mark its most hazardous places, there are others, hidden beneath the waters that wash our shores, perhaps equally perilous, which can only be ascertained, and become generally known, by accurate soundings and charts.

Independently of the ordinary results of the operations of the Coast Survey, as given in the annual reports and preliminary sketches and maps, two great natural approaches, before unknown, have been discovered, and verified in such form as to mark them distinctly for use by the mariner; we refer here to Gedney's channel in the harbor of New York, and to Blake's channel in Delaware bay.

Of equal merit, but not yet so distinctly made available for practical purposes, are the newly discovered shoals off Nantucket, the examinations of Chesapeake and Mobile bays, and some of the dangerous parts of the coast of North Carolina.

The investigations of the width and direction of the current of the Gulf stream, that great physical wonder, its temperature and depth, will no doubt be of as great practical, as it is of scientific, interest. The phenomena of the tides, and of the currents of the oceans and rivers which wash and water our

territories, the nature and changes of the bottom, both in the shallow and deep places, are highly curious and practical.

Nor ought we to overlook, in such a summary, the accurate delineation of the topography of the country bordering the shores. On every side, and every where, the survey applies the scale of truth and science to the crude and imperfect locations and measurements of former times, and presents us with perfect, or nearly perfect, work.

Entrances to harbors and bays have been found to vary from the received proportions by miles—light-houses and dangerous points in the navigation have had their locations corrected, and the confiding mariner made safe in his approaches.

It is only necessary for any one who doubts these great results to procure the most approved of the old charts and maps, and compare them with the work of the Coast Survey. The members of the Institute may readily do this, by an examination of the new chart of Delaware river and bay; they will rise satisfied, from such an examination, that every attention has been given to secure accurate results; and it will be apparent to them how valuable similar works must be to their fellow-citizens in other parts of the Union. But it is unnecessary for us to confine ourselves to the commerce of the nation in an enumeration of the practical benefits of the Coast Survey. The work that has been wrought out with so much care and accuracy, to fix prominent points along the coast, may be equally relied on by the State and municipal authorities, for local or more extended measurements, by the triangulation of the areas of cities, counties, and States.

As land becomes valuable, and the conflicts for its possession increase in number, the importance of authenticated measurements, made independently of any such considerations, will be more and more obvious; and it will doubtless soon become the policy of each State, if not of the subordinate parts of it, to compare the boundary lines of public and private locations, as they now imperfectly or arbitrarily exist, with great triangulations of the national work; and correct them with, and mark their relation to, these measurements, by the application of the same methods that are now used in them. By such a system, not only would private litigation on the subject of boundaries be much diminished, but accurate maps would be produced, and take the place of those imperfect and deceitful sketches now in use.

Of the scientific methods used in the labors of the Coast Survey it will be sufficient for us, perhaps, to say, that they embrace all that is now known, either in this country or in Europe; and that, in the establishment of new formulæ, or in the application of old ones, those entrusted with the work maintain a high position.

Our limits will not permit us to institute comparisons between the rapidity and correctness with which our work is going on, and those of similar character that are now making by other nations. The testimony of Col. Everest, who recently visited this country, and who was charged with the superintendence of the great survey of India, emphatically marks it as equal to any with which he is familiar. And we know, by an examination of the history of the published results abroad, that the survey of the coast of the United States is more rapidly prosecuted than any other national work, and its results placed in the possession of the public with more promptness.

In point of economy, although from its nature large amounts of money must be annually expended, it can scarcely be said to exceed the price of our ordinary surveys of the public lands, while its results are much more to be relied on.

This economy is, in a great measure, due to its peculiar organization; while it embraces army and navy officers of the medium grades, and uses their pecu-

liar professional skill and knowledge, it relies more largely on the employment of civilians, and thus blends into harmonious action those who can best contribute to its great objects. The Superintendent is of course a civilian, and such should be the case from the very nature of his duties. They are varied, comprehensive, and require peculiar habits of thought and action, that are rarely attained in the camp or on board the ship. The chief of the survey cannot, without great hazard, be rendered subject to the contigencies which affect the the military and naval service, because the great value of his labors depends upon the soundness and extent of first preparations, and the gradual but steady filling in of the details marked out by previous study. The computations, drawings, observations, and measurements, the engravings and other artistical work connected with the subject, must, to a great extent, be the work of civilians; and while the head should be able to command the respect and confidence of military and naval officers of the country, he ought also to be possessed of that practical knowledge of scientific and mechanical pursuits, that will enable him personally to direct and control the minutest details. In these respects we consider the work most happily organized, and tending to the best results. The arrangements by which the services of the different individuals employed are adjusted, the proper distribution of labor among them, and the subdivisions of the corps into effective working bodies, are all well adapted to secure harmony and efficiency. The success of these arrangements is well shewn in the published results, and if the finished maps be considered merely in the light of mechanical productions, they will reflect high credit on the artists; but when they are examined with reference to their scientific and practical value, the skill and talent bestowed upon them challenge the most delicate criticism.

The committee has been struck with the perfection of the organization of the business of the survey.

It has been arranged so as to meet the complicated responsibilities of a large number of individuals of different capacities, and laboring in different fields, but whose results must be combined in order to perfect the whole work. Each of these different individuals is, in some sense, a check upon the whole, and he either contributes to the correct result, or is himself convicted of error.

In this respect, the survey is a great national scientific school, in which the young men from all parts of our extended country may actively participate in its labors in the field, or, by means of its connexion with our colleges and other schools, become familiar with its methods of examination and computation, and compare them with those which claim the attention of the educational institutions and scientific men of Europe.

We have already glanced at its economy, and, in connexion with what we are now considering, we would say that, independently of the vast practical benefits which are flowing from the work, a nation like our own might well afford to contribute its quota to the sum of human inquiry, by keeping a portion of its citizens, equal in number to those now employed in the survey, engaged in the investigation of the several branches of physical science that fall regularly within its duties. In these relations it connects us with the movements of general science throughout the civilized world, and will enable the men of science of our own land to vie with the philosophers of other nations in the value and extent of their investigations. Spread, as these investigations are, over many States, local prejudices retire before the lights which they furnish, and every new field that they reach will, in its turn, yield fruit to the general harvest.

If we direct our attention to the scientific character of the Coast Survey, we find that it is making large contributions to knowledge and the arts. It calls to its aid all the physical sciences, and applies them for the determina-

tion of valuable practical results. Thus, the higher mathematics used in the reductions of the astronomical, magnetic, and geodetic observations, give formulæ which may be applied to objects entirely distinct from the immediate work.

The explorations of the depths and bottoms of our sea-coast, bays, and rivers, afford a large field for the more minute investigations of the botanist, the geologist, and the observers of all kinds who delight in the examination of animal life in its various extended forms. The topography makes us familiar with the character of the surface, and the nature and extent of the cultivation of the soil.

The magnetic and meteorological observations will become valuable in their applications to the study of climate and general temperatures. The observations for latitude and longitude will designate with certainty the true positions of our cities, and other places of interest in a national point of view; and give greater precision to our knowlege of the sphericity of the earth, and of the relations of the meridional and equatorial arcs which are within the extended bounds of the survey.

It has given rise to improved methods of observing angles and azimuths, and has furnished valuable formulæ and tables for determining latitudes and longitudes, by reference to its great bases. It has brought the aid of the magnetic telegraph, and magnetic and electric clocks, to practical use in the determination of the longitude of our cities and important inland points. New and improved apparatus has been constructed for ascertaining temperatures; for constructing and dividing the delicate instruments used in the terrestrial and astronomical measurements; for determining the meteorological and magnetic states of the atmosphere; for discovering the true character of the soundings; and for measuring the direction and velocities of tidal and oceanic currents. The astronomical observations will embody a vast amount of information on the subject of celestial phenomena, and by their number and extent tend greatly to the verification of those results that have been obtained by the terrestrial measurements. It is difficult, indeed, to determine where its value, in a strictly scientific sense, would terminate; because it explores every walk of known science, and is daily returning new discoveries for the aid which the elder ones had furnished to it.

After a careful consideration of the whole subject embraced in the examination of the Coast Survey, the committee would express the following conclusions:

First. That the work is national in its character, and ought to be continued by the Federal Government upon a scale commensurate with its practical importance, and with the extent and variety of the objects which are benefitted by its results.

Second. That the manner in which it is at present organized is economical, efficient, and scientific; giving its results with sufficient rapidity, at moderate cost, and upon correct scientific and practical principles.

Third. That its labors ought to be (as they now are) divided among the civil, military, and naval talent of the country, in order to secure to each of these departments that knowledge of its processes and determinations which are equally required by them all.

Fourth. That the benefits which the nation has already obtained from it have fully justified its cost, and that those benefits ought now to be continued to the whole of the States of the Union, upon as broad and liberal a scale as the Government has hitherto applied.

By order of the Committee:

WILLIAM HAMILTON, *Actuary.*

Philadelphia, February 8th, 1849.

RESOLUTIONS *by the* BOARD OF TRADE *of* PHILADELPHIA *relative to the Coast Survey.*

At a stated meeting of the Directors of the Philadelphia Board of Trade, held on Monday, the 19th of February, 1849, the following resolutions were unanimously adopted:

Resolved, That the survey of the coast of the United States is a great National work, and that it ought to be prosecuted upon broad and liberal principles, so as to secure the most rapid publication of its results, and extend its examinations over the greatest surface.

Resolved, That as at present organized it is progressing rapidly, economically, and making valuable publications, for the use of the mariner, merchant, and underwriter.

Resolved, That its present organization is that which is calculated to produce the best results, and to lead to that harmony and efficiency which are essential to success in so complicated a service.

Resolved, That we should view the abandonment of the Coast Survey, or any limitation upon its present extent and plan, as a public injury, and would deplore it, as a failure in those National obligations which our country owes to the civilized world.

Resolved, That the above resolutions be published, and copies transmitted to our Representatives at Washington.

BALTIMORE, *January*, 1849.

We, the undersigned underwriters, merchants, owners, and masters of vessels, citizens of Baltimore, having had our attention directed to the operations of the Coast Survey of the United States, as conducted by Prof. Bache, hereby desire to express our approbation of the work, and our opinion that it is to the interest of the public generally that it should be continued.

We believe that the various discoveries of new channels, new shoals, and other important data upon which correct sailing directions are founded, give ample evidence of the zeal and industry of those engaged in the work, and will, no doubt, prove of great importance in the safe navigation of our coast and harbors.

A. J. SCHWARTZE,
Prest. of the Amer. Mutual Ins. Co. of Balt.
SAM. T. THOMPSON,
Prest. of the Atlantic Mutual Ins. Co. of Balt.
WM. GRAHAM,
Prest. Merchants' Mutual Ins. Co. of Balt.
EDWD. DIDIER,
Prest. of the Mutual Marine Ins. Co.
ALEX. BROWN & SONS, and others,

MEMORIAL *of the Faculty of* ST. JOHN'S COLLEGE, MARYLAND, *in relation to the U. S. Coast Survey.*

ST. JOHN'S COLLEGE, *Annapolis, Jan. 12th*, 1849.

To the Hon. Senators of the United States:

The President and Professors of St. John's College having heard that dissatisfaction exists in the minds of some as to the present condition and progress of the Coast Survey, beg leave to express to your honorable body our perfect confidence in the wisdom and skill of the Superintendent of that work, and in the fidelity and success of the gentlemen employed under his direction. We have been greatly pleased with the rapid advancement of this noble and national undertaking under the management of Prof. Bache; and we have derived the highest gratification from the accuracy and beauty of the maps and charts which have proceeded from that office since it was placed in his keeping. This feeling of patriotic pride we should deeply regret to have marred or diminished by any change that may be contemplated in the method or direction of these

most responsible operations, which are doing so much to raise our country in the estimation of foreign nations, and contributing so materially to the safety and extension of commerce and national wealth throughout the world. We believe it would be madness to arrest these delicate investigations in the hands of men who are in every way fully competent to pursue them, or to embarrass them by any temporary discussions which must call off the attention of the officers in charge from their arduous duties. And we hope and pray that this work may be suffered to go on to its completion without any retardation—such as must necessarily arise from dragging it into the field of public debate. We think that the world has never before seen so wide a field opened at once for scientific explorations in astronomy and geodesy, as is now presented in our conquests and acquisitions at the West, especially on the shores of the Pacific seas. To interfere with the progress of this grand series of operations at such a moment, when so vast a future is suddenly unfolded to the irrepressible energies of our countrymen, could not fail to be highly injurious to our best national interests, and to diminish the glory that we have already won in adding those territories to the stewardship of the American people. We therefore pray your honorable body not to entertain any proposition that is unfriendly to the uninterrupted prosecution of its present most able managers.

We have the honor to be, with the highest respect, your most ob't sev'ts,

HECTOR HUMPHREYS,
President and Prof. of Moral Science.
EDWARD SPARKS,
Prof. of Ancient Languages.
DAVID J. CAPRON,
Prof. of Math. and Civil Engineering.
CHARLES EDWD. ANTHON,
Prof. of Modern Languages.
WILLIAM H. THOMPSON,
Prof. of Grammar.

LETTER *from the Professors of the* UNIVERSITY OF VIRGINIA *relative to the U. S. Coast Survey.*

UNIVERSITY OF VIRGINIA, *January*, 1849.

GENTLEMEN: We learn with surprise and regret that a resolution has been submitted to the United States Senate proposing to repeal the act authorizing the employment of civilians in the survey of the coast of the United States.

The immediate effect of such a proposition, if adopted by Congress, would be to dispense with the services of the present distinguished Superintendent of the survey, and to discharge more than three fourths of the valuable corps of assistants now employed in the work, many of whom have devoted their time and attention exclusively to it for several years.

In the execution of a survey, such as that now in progress under the authority of the General Government, the requisite accuracy can be secured only by employing the most refined methods of geodesy, and by a familiarity with all the collateral branches of science which exercise a direct influence on these methods. To the Superintendent of such a work should belong not only the purely scientific qualifications required in the subordinate officers, but also that administrative talent so necessary in directing the labors of others, whose duties are to be discharged at points the most remote from each other.

The importance of concentrating upon this truly national work the most eminent talent, and the most varied scientific attainments which the country can afford, would seem to render it inexpedient under any circumstances to limit

unnecessarily the field from which the selection of its officers is to be made. And these general considerations apply, in our judgment, with peculiar force in the present instance, while the survey is under the direction of a gentleman eminently fitted for the discharge of his arduous and responsible duties.

We beg, therefore, respectfully, but earnestly, to express our convictions, that any modifications of the existing law, in relation to the Coast Survey, requiring the appointment of officers from the military and naval services exclusively, would be attended with results prejudicial to the best interests of the public service.

We have the honor to be, very respectfully, your obedient servants,

EDWARD H. COURTENAY,
GESSNER HARRISON,
M. SCHELL DE VERE,
R. E. ROGERS,
JOHN B. MINOR,
H. HOWARD,
J. L. CABELL,
W. H. McGUFFEY.

To Hon. JAMES M. MASON, } *U. S. Senate.*
R. M. T. HUNTER, }

UNIVERSITY OF VIRGINIA, *January* 31, 1849.

In consequence of my absence from the University, I was unable to unite with my colleagues in their memorial in behalf of the present organization of the Coast Survey. I now beg to express my cordial concurrence in the views and arguments presented in that communication. WM. B. ROGERS.

RESOLUTIONS *of the* CHAMBER OF COMMERCE *of* CHARLESTON *in relation to the Coast Survey.*

Resolved, That the Chamber of Commerce of Charleston have heard with peculiar gratification that the Coast Survey, which has produced benefits of such magnitude to other sections of the Union, has at length been commenced on the coast of South Carolina, and in the harbor of Charleston, under the direction of the present very efficient and scientific head of the Coast Survey, Professor Bache.

Resolved, That this chamber considers this survey as a work of more utility and importance to Charleston, and the extensive country of which it is and will be the outlet, than any work that the General Government has ever undertaken for it; and that we shall watch its progress and early completion with the deepest interest.

Resolved, That the examination of the harbor, and all its approaches; the accurate ascertainment of the currents and channels; the volume, force, and speed of the waters that flow and reflow through them; the exact locality and influence of the natural and artificial barriers, shores, and obstructions, which control or affect them, and which do, or may be so made as to bear upon the channels and outlets to the sea, so as to open or to deepen these highways of commerce to this city, will be of such value as to call upon this chamber to give to the survey every aid and assistance in its power; for which purpose a standing committee of five members be appointed, to be at all times in communication with the officers engaged in such survey, and to extend to them any aid and information they may require within the ability of the chamber to extend.

Resolved, That the surveys which have been made with so much scientific and professional ability under the present able head of the Coast Survey, Professor Bache, is a warrant that, if carried on and completed by him for our

coast, nothing will be omitted to render the work as perfect as it is capable of being made.

Resolved, That the General Government, having already expended one and a half million of dollars in surveying and preparing accurate charts for the great commercial ports of the north and its sea coast, and also for partial surveys and examinations of the coasts of Texas, Louisiana, Mississippi, Florida, and Alabama, that those of Georgia and the Carolinas ought also to be completed; and that to repeal the acts of Congress authorizing this survey, before its benefits have been extended to those who have not yet had them, would not be just.

OFFICE OF THE MOBILE AND OHIO RAILROAD COMPANY,

February 10, 1849.

At the annual meeting of the stockholders of this company there was a large assemblage of citizens and sojourners in our city, who joined most cordially in the resolutions I have the honor to enclose. I am requested to ask you to make such use of them, in Congress or the Departments, as will bring to notice the high approbation by this community of the "Coast Survey," especially as conducted by its present chief, Professor Alexander Dallas Bache. It is to the labors of this gentleman, and the officers under his direction, that we are indebted for the knowledge we have of the Mobile waters; the bay is not merely a capacious bay, but as the depth of the waters, and the seaward movement of the bar are ascertained facts, it is conclusively established to be the best harbor on the Gulf of Mexico. The late arrival and departure of the British royal mail steamer Dee certifies these facts, to which we have added the certificate of the pilot, who took the ship out, that he had over twenty-four feet water on the most shallow points of the bar. *It is a bar no more;* and Congress and commerce will ere long find this port the best for the Government vessels, and for the arrival and departure of the largest class of ships in safety; and while in port the harbor affords the most complete protection against storms from any point of the compass. Another reason for the favorable action of Congress may be found in the opening of our railroad, which brings us to the granary of the world; for, whatever may be the varied views of internal improvements, it is yet deemed legitimate to foster and protect the commerce of our country.

With great respect, your obedient servant,

SIDNEY SMITH, *President.*

To the Hon. WM. R. KING, *of the Senate of the U. S.*
Hon. JOHN GAYLE, *of the House of Reps.*

OFFICE OF THE MOBILE AND OHIO RAILROAD COMPANY,

February 9, 1849.

At a meeting of the stockholders of this company, held in Mobile on Monday the 5th instant, the following resolutions, offered by S. Griffitts Fisher, esq., were unanimously adopted:

Resolved, That this meeting cordially recommend to the favorable notice and action of Congress the continuation of an energetic and active prosecution of the Coast Survey, as a work of the greatest utility to the various interests of the Union, and calculated to reflect honor upon the intelligence and patriotism of this country.

Resolved, That the thanks of this meeting be tendered to Professor Bache, and the officers under his direction, for the zeal and success with which their duties have been performed in the bay and harbor of Mobile.